Transportation Energy

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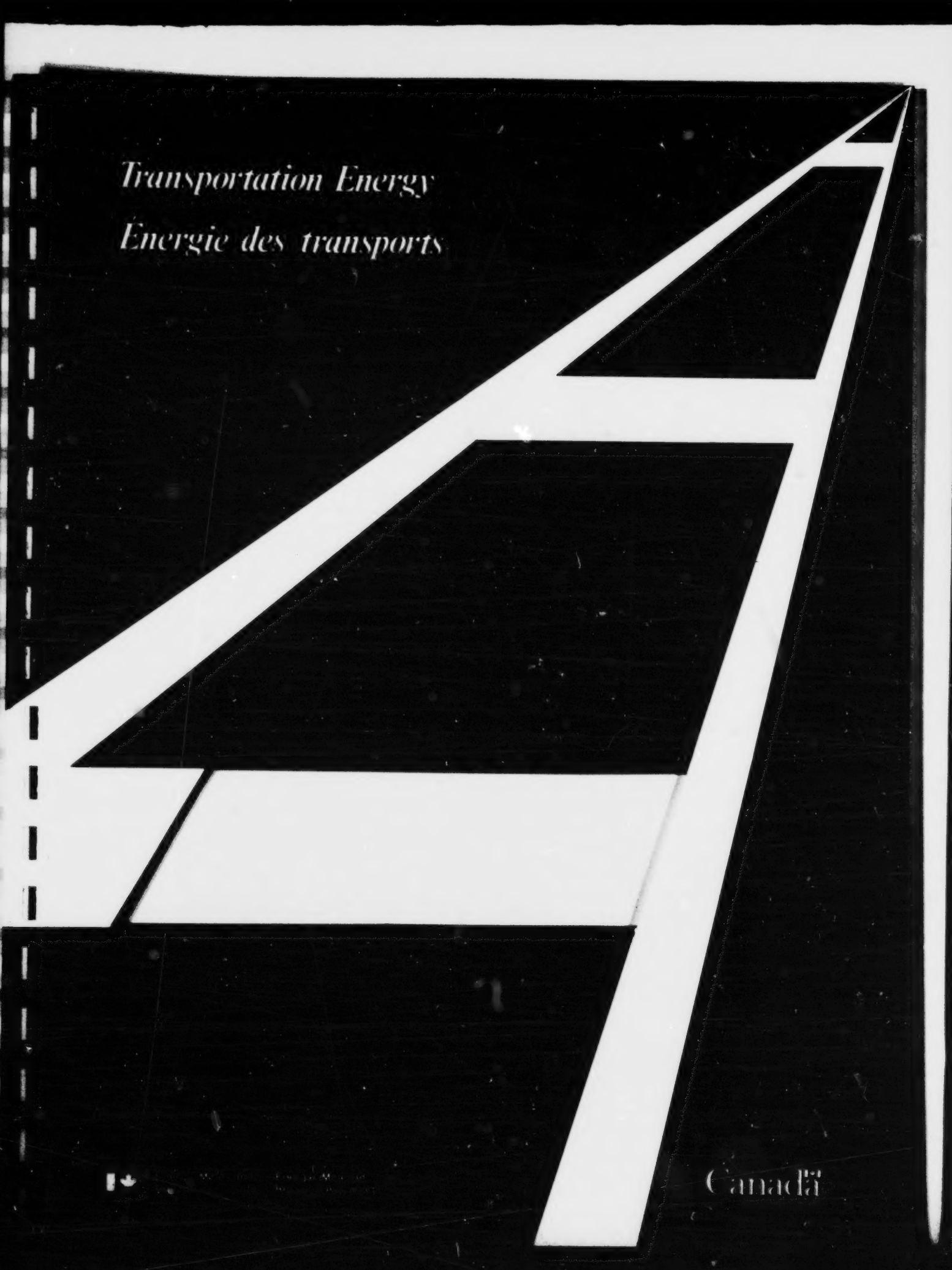

Canada

TRANSPORTATION ENERGY DIVISION
ENERGY, MINES & RESOURCES CANADA

Fuel Consumption of New Motor Vehicles in Canada

October 1985

Report TE-84-15

DISCLAIMER

This study was carried out with the cooperation of the Department of Energy, Mines and Resources. However, the views expressed in the report are those of the author and do not necessarily reflect the views of the Department.

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EXECUTIVE SUMMARY

In response to dramatic oil price increases and supply disruptions in the 1970's, most industrialized countries moved quickly to establish programs that would reduce dependence on imported oil. Both the United States and Canada initiated programs to both stimulate supply and curtail or modify demand.

The important role of the transportation sector as consumer of about half of all petroleum called for concerted effort aimed at this sector. In Canada the Motor Vehicle Fuel Economy Program was established in 1977 to reduce oil consumption by encouraging the production, marketing and purchase of more fuel-efficient light-duty vehicles. The program was administered an a voluntary basis and closely parallelled the U.S. mandatory program.

The purpose of this paper is to review the progress made in light-duty vehicles in the 1978-1985 period, discuss factors that influenced this progress, and identify opportunities for further conservation in the light-duty vehicle segment of the transportation sector.

CONSERVATION PROGRESS IN LIGHT-DUTY VEHICLES

What Has Been Achieved?

Canada has experienced dramatic reductions in gasoline demand since the peak in 1980. Although many factors have been at work, new vehicle fuel efficiency improvements since 1978 are estimated to have accounted for gasoline savings of 5 million litres per day in 1984.

The average fuel consumption of passenger cars based on government approved tests decreased from 16.81 L/100 km in 1973 to 8.6 L/100 km in 1985, a 49% improvement. For all years but 1981, the fuel efficiency performance of the Canadian new car fleet was better than that of the U.S. fleet. Similar improvement in the light-duty truck fleet was observed.*

For the on-road fleet as a whole (all model years), average fuel consumption improved by 18% between 1978 and 1985.

How Has It Been Achieved?

During the ten-year period 1974-1984, North American automobile manufacturers and consumers invested heavily in improved technology, product design and manufacturing processes. These investments have led to a number of changes that are not only interesting in themselves but offer some useful comparisons between Canada and the U.S.A.

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* In this report, unless otherwise noted, light-duty trucks refers to trucks which are of a 6,000 pound or less gross vehicle weight rating (GVWR).

In new passenger cars, average vehicle weight declined from 3526 lb in 1978 to 2941 lb in 1985, with 1984 new cars being 224 lb lighter in Canada than in the U.S.A. A dramatic sales shift by weight class also took place, with the 4,000 lb class being replaced by the 2750 lb class as the largest seller. The entire decrease in average weight is attributable to changes in North American (domestic) vehicles. The average weight of Asian and European vehicles has remained relatively unchanged since 1978.

Almost 30% of Canadian new cars have manual transmissions in 1985, compared with 21% in 1978. Manuals offer 5-10% better fuel efficiency than an automatic transmission fitted with overdrive.

The use of fuel injection is more widespread in the U.S.A., where it reached 38% in 1984, compared with 20% in Canada. Different emissions standards and shortage of components are probably the main factors accounting for this difference.

Average engine size of domestic vehicles sold in Canada dropped from 4.7 L to 3.0 L. Engine displacement to vehicle weight ratio also decreased. New engine technology such as turbocharging permits the use of smaller engines without loss of performance.

Overall diesel passenger car sales increased from 0.6% of total sales in 1978 to 2.0% in 1985. The large market penetration of diesel-powered passenger cars that many anticipated in the late 1970's has not occurred.

Foreign manufacturers have increased their market share from 20% in 1978 to almost 30% in 1985. Market share for Japanese vehicles peaked in 1982, at which time voluntary export restraints were applied. Market shares aside, the improvements in new car fleet fuel consumption are largely attributable to actions by North American Manufacturers. Currently, for any given weight class, domestic cars are equal to or better than imports in terms of fuel consumption.

For light-duty trucks (LDTs), comparative data for the U.S. fleet were not available at press time for the 0-6000 lb Gross Vehicle Weight Rating range; therefore the data presented pertains to Canada only. The light-duty truck category includes pick-ups, vans and special-purpose vehicles. Special purpose vehicles are trucks and automobiles that are intended for off-road use.

In 1979 the average new LDT weight in Canada was 4146 lb. By 1983 this had dropped to 3331 lb, a reduction of 20% (compared with 18% for passenger cars). Average fuel consumption improved by 19%. For 1984 and 1985, average weight increased slightly, but average fuel consumption remained unchanged. (Weight reductions are attributable to similar factors as for passenger cars.) Until 1983, the principal changes in fuel consumption appear to have come from weight reductions in pick-ups and a shift from vans to special-purpose vehicles (SPVs). Introduction of smaller vans in 1984-85 dramatically decreased average van weight.

In 1979, 74.5% of LDTs were delivered with automatic transmissions. By 1982, this figure had dropped to 42%, but it rose to 51% by 1985. An important change was increased use of torque-converter lock-up. The use of front-wheel drive has not become extensive, but it is now seeing application in down-sized vans.

Average engine displacement in LDTs dropped from 4.7 L in 1979 to 3.2 L in 1985. The biggest change was in vans. The reduction is evidenced by a major shift away from eight-cylinder engines. Almost 50% of LDTs in 1985 will have four-cylinder engines. Most of these will be coupled to manual transmissions.

The overall penetration of diesels in LDTs increased from 3.5% in 1979 to a peak of 9.9% in 1982, then decreased to 5.4% in 1985. Diesel utilization is almost zero in vans. The fuel consumption advantage of diesel engines has been offset by the higher initial cost of vehicles equipped with a diesel engine which has discouraged potential buyers from selecting diesel engines.

Light-duty vehicle use, when measured as total distance driven, can be shown to have increased slightly over the 1978-83 period. Fuel demand reductions, then, would appear to be entirely attributable to improved new vehicle fuel efficiency and conservation practices.

FACTORS INFLUENCING CHANGE

The dramatic improvements in fuel consumption have been influenced by many factors. It is difficult, probably impossible, to determine the precise influence of each of the following factors.

Fuel Prices

Real gasoline prices increased by 45% during the period 1978 to 1984. Studies of fuel-price/fuel-consumed elasticity indicate that fuel consumption should drop within increasing fuel price. Comparison of U.S. and Canadian fuel price differences coupled with differences in each country's vehicle fuel efficiency is evidence of the important influence of fuel prices.

Foreign Competition

The demand in North America for fuel-efficient cars during the 1970's created an opportunity for Japanese and European manufacturers. The market share for imports peaked at 35% in 1982, when voluntary export restraints were applied to Japanese vehicles. Although the competition from foreign manufacturers is not expected to subside, changes in industry structure such as joint ventures and global sourcing of components are blurring the traditional distinctions between domestic and import products.

Buying Patterns

A clear shift of consumer interest to smaller cars has taken place. Compact cars increased from 18% of sales in 1978 to 30% in 1984, while large cars went from 15% to 7% during the same period. Data for 1985 indicate some re-emergence of interest in larger vehicles along with more interest performance orientated cars.

Government Programs

Government initiatives in both Canada and the U.S.A. have attempted to ensure that potential fuel efficiency improvements are realized. Since the Canadian automobile industry is heavily influenced by activities in the United States, the U.S. programs are also discussed.

The legislated U.S. Corporate Average Fuel Economy (CAFE) standards have called for a 50% improvement in new car fuel economy from 1978 to 1985. The CAFE program also includes publication of annual vehicle ratings, and fuel economy labelling of vehicles by manufacturers. Light-duty trucks were included in the program beginning in 1979.

The U.S. Gas Guzzler Tax, a schedule of progressively more stringent levies based on automobiles fuel economy, is perceived to have influenced manufacturers to improve dramatically the fuel efficiency of certain large domestic vehicles thereby avoiding the tax. In some instances model lines were discontinued rather than pay the tax.

The Canadian Motor Vehicle Fuel Economy Program is similar to the U.S. program, except that the Canadian program is voluntary. To date all major manufacturers have met the fuel consumption objective of the program. Ford and General Motors have used carry-forward credits earned in previous years to meet the 1983 and 1984 objective . Ten other, smaller manufacturers have also needed to use credits. Together these twelve companies represent 53% of the new car sales market.

Public information and education programs operated by the Canadian government are believed to have had some influence on the purchase of new vehicles. About 5% of new car buyers have used the Fuel Consumption Guide in their purchase decisions. Because of the relatively low cost of the Guide, it is thought that the government is obtaining a reasonable return on its expenditures. Concerning advertising, government guidelines have contributed to fairness and clarity. Vehicle fuel consumption labels are also believed to influence consumers, but their removal by dealers has been a problem.

In 1975 the Canadian government introduced a graduated excise tax based on vehicle weight to discourage the purchase of heavier cars. The tax initially applied to less than 10% of passenger cars sold and now applies to less than 2%. The tax's impact on manufacturer design and consumer purchase decisions has been minor.

A $100 excise tax has also been applied to automotive air conditioners, as these increase fuel consumption. It has been collected for an increasing volume of sales, and revenues are now about $20 million a year. The tax's impact on over-all fleet fuel consumption is difficult to determine.

FUTURE CONSERVATION OPPORTUNITIES

Extensive automotive research has led to the identification of several methods of further improving fuel consumption. The technologies may be grouped into three areas:

- vehicle programs such as, weight reduction, and aerodynamic drag reduction;
- drivetrain improvements such as more efficient transmissions, lubricants, tires;
- engine improvements such as electronic controls, power boosting, reduced internal friction, lean burn.

Simultaneous implementation of technologies in these three categories could readily achieve a further 30% improvement in automotive fuel consumption.

Alternative-fuelled vehicles also offer a method of reducing oil consumption through displacement of gasoline demand in the new vehicle fleet.

Over the next few years the benefits of technological changes introduced in response to past events will continue to be realized as new, more efficient vehicles displace their less efficient predecessors. Competition from foreign manufacturers as a technology forcing factor will also continue to be a factor, although less important than in the past as joint ventures between Domestic and Asian manufacturers solidify.

Consumers are an important factor in Canada's average fleet fuel efficiency performance. Although there has been some increase in consumer interest in larger cars, the shift is not dramatic. Currently consumers are focussing on middle-range sizes much as compacts that offer economy yet still meet their functional demands.

Technology is now available, or will soon be available, that can provide continued fuel efficiency progress. To what extent this progress will continue depends on a great many factors, including the extent of industry, government and consumer commitment.

ACKNOWLEDGEMENT

Data contained in this report on the characteristics of the U.S. motor vehicle fleet were provided through the courtesy of the United States Environmental Protection Agency Ann Arbor, Michigan, whose assistance is hereby gratefully acknowledged.

Sources of raw data are detailed in Appendix I.

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1. INTRODUCTION

The availability of low cost energy in the form of oil was a major factor in the industrial and social developments that occurred in the 20th century. Massive transportation systems evolved in North America centered around the private automobile as the main means of personal transport for both business and pleasure. Houses became larger, factories produced more durable goods, international travel became widely available, and petrochemicals created the products for a throwaway society. So intensive was the thirst for oil and its derivatives that consumption of oil in Canada increased nine-fold in the twenty-eight years from the end of World War II until 1973.

The era of low priced oil came to an abrupt end in 1973 when the Arab nations boycotted oil shipments to countries sympathetic to Israel in the Arab-Israel War. Oil prices increased four-fold from about three to twelve dollars per barrel over a two-month period. Shortages occurred in several Western nations, notably the U.S.A. where long line-ups at filling stations were a common sight. Governments of Western nations were suddenly made aware of their dependence on Mid-East oil and the fragility of this source of supply for such an essential commodity.

Most industrialized countries moved quickly to establish programs that would reduce dependence on imported oil. At the international level, governments responded by forming the International Energy Agency (IEA) in November 1974 to co-ordinate plans of Western nations both to reduce oil consumption and to share oil supplies during periods of shortage. The IEA included among its policy statements support for fuel economy standards for new motor vehicles.*

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* For a detailed comparative analysis of fuel economy programs in IEA member countries, see the IEA Report, Fuel Efficiency of Passenger Cars, Paris, OECD, 1984.

In 1975 the United States Congress passed the Energy Policy and Conservation Act which was intended to stimulate production of domestic oil and to encourage oil conservation. A key provision of the Act was to promote greater fuel economy* within the U.S. transportation sector. The Act established mandatory fuel economy standards for automobiles and light-duty trucks sold in the U.S. and provided for stiff financial penalties to vehicle manufacturers in the event that they did not comply with the standards. Other U.S. programs included those to encourage the development of synthetic oil from both coal and oil shale. A Strategic Petroleum Reserve was also initiated to bank large volumes of crude oil for use during periods of restrained supply.

The problems and issues faced by Canada as a result of the oil crisis were similar to those faced by the U.S. Although Canada continued to be a net exporter of energy, it had for some years been a net importer of oil and therefore vulnerable to unstable sources of foreign supply. The Canadian government in the years following the 1973 oil crisis responded with a comprehensive set of programs. Exports of Canadian oil to the U.S. were curtailed, oil price adjustments were established to encourage development of new oil supplies and exploration incentives were introduced to aid in the search for new supplies in the remote regions of Canada.

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* The terms "fuel consumption", "fuel economy" and "fuel efficiency" are often used interchangeably. However, their meanings can be different. In this report, "fuel consumption" refers to the amount of fuel consumed per unit of distance travelled, and is expressed as litres per 100 kilometres. "Fuel economy" is the inverse of fuel consumption, and is expressed as miles per gallon. United States gallons are used unless otherwise noted. "Fuel efficiency" is a generic term that encompasses both concepts; in this report it is used in non-numeric contexts.

The distinction between fuel consumption as used in Canada and fuel economy as used in the United States, can be important, for example when referring to percentage improvements. In the schedule of standards and objectives shown in Table 2 the improvement in fuel efficiency between 1978 and 1985 is 53% when expressed in terms of fuel economy, and 34% when expressed in terms of fuel consumption.

On the demand side, programs were introduced to conserve energy in both the residential and industrial sectors and to facilitate conversion from oil to other forms of heating for homes. These programs included both financial assistance to consumers and public information campaigns. Development of alternative energy forms such as solar, biomass, wind, tides, and nuclear were encouraged through increased federal research and development funds.

The role of the transportation sector as a major oil consumer demanded a concerted effort if total Canadian consumption was to be curtailed. Indeed the transportation sector was the largest single user of petroleum products in Canada, accounting for 48% of each barrel of petroleum consumed in 1973 and 58% in 1982 (Figure 1). Within the transportation sector, automobiles and trucks under 10,000 lb. Gross Vehicle Weight accounted for 85% of the gasoline used. By the early 1970's North American automobiles consumed almost twice as much fuel per kilometre travelled as the typical Japanese or European import.

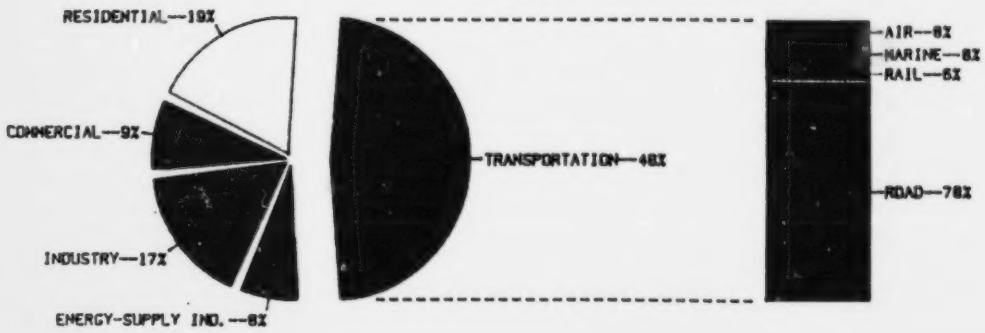
It was apparent that significant opportunities were available to improve fuel efficiency in automobiles and that U.S. initiatives would yield some benefits to Canada. It was important to ensure that Canada would realize the full benefit of new vehicle improvements in the U.S.A., as well as demonstrating to the industry and to the public the Canadian government's commitment to energy conservation. The Motor Vehicle Fuel Economy Program was established by the federal government in 1975 with the objective of reducing oil consumption in road transportation through:

- encouraging the design, manufacture and sale of more fuel efficient vehicles in Canada and;

- providing information to consumers assisting and encouraging them to purchase the most fuel efficient vehicle that met their requirements.

Although the program was to come into effect for Model Year 1980, in 1976 the North American manufacturers committed to the government in

FIGURE 1-A
CANADIAN PETROLEUM CONSUMPTION BY SECTOR
1973

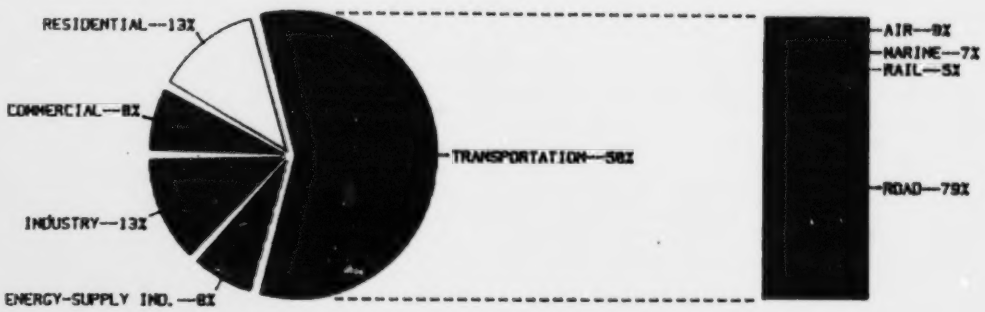


1973
TOTAL - 230 MILLION LITRES/DAY

TRANSPORTATION

SOURCE: EMR/TED DATA BOOK

FIGURE 1-B
CANADIAN PETROLEUM CONSUMPTION BY SECTOR
1982



1982
TOTAL - 205 MILLION LITRES/DAY

TRANSPORTATION

SOURCE: EMR/TED DATA BOOK

LEAVE BLANK FOR FIGURE 1-A

meeting the program's objective in Model Year 1978. The program closely paralleled the mandatory program established in the U.S.. The Canadian program, however, was administered on a voluntary basis. The main elements of the program included:

- establishment of progressively more stringent fuel consumption objectives for new passenger cars;

- annual publication of the Fuel Consumption Guide containing information for consumers on the fuel consumption rating of most new light-duty vehicles (light-duty trucks with a Gross Vehicle Weight Rating greater than 6000 pounds are not included).

- labelling of all new passenger cars indicating the fuel consumption rating of each vehicle; and

- requirement for vehicle manufacturers and importers to submit motor vehicle fuel consumption test data to the government.

Details of the Motor Vehicle Fuel Consumption Program are given in Appendix II.

The purpose of this background paper is to review progress in reducing the energy demand imposed by light-duty vehicles in the 1978-1985* period; to discuss the factors that influenced this progress; and to identify the opportunities for further conservation in this segment of the transportation sector.

2. CONSERVATION PROGRESS IN LIGHT DUTY VEHICLES

Prior to the 1973 oil crisis, the fuel efficiency of light-duty

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* 1978 has been selected as the base year for this paper because it was the first year for which complete data was available for both the United States and Canada. Publication of comparative vehicle ratings in Canada commenced in 1977. Data for 1985 are fuel consumption estimates based on information provided by manufacturers to the government.

vehicles was of little concern to most consumers. North American auto buyers were interested in comfort, styling, performance and power. After the oil crisis, a host of factors including gasoline price, gasoline supply, competition from more efficient foreign vehicles, government programs, and a shift in consumer preference toward more fuel efficient vehicles, combined to produce dramatic improvements in light-duty vehicle fuel efficiency in the domestically produced fleet.

In this section achievements are identified, the changes that have occurred in light-duty vehicles are discussed, and the factors influencing the changes are noted.

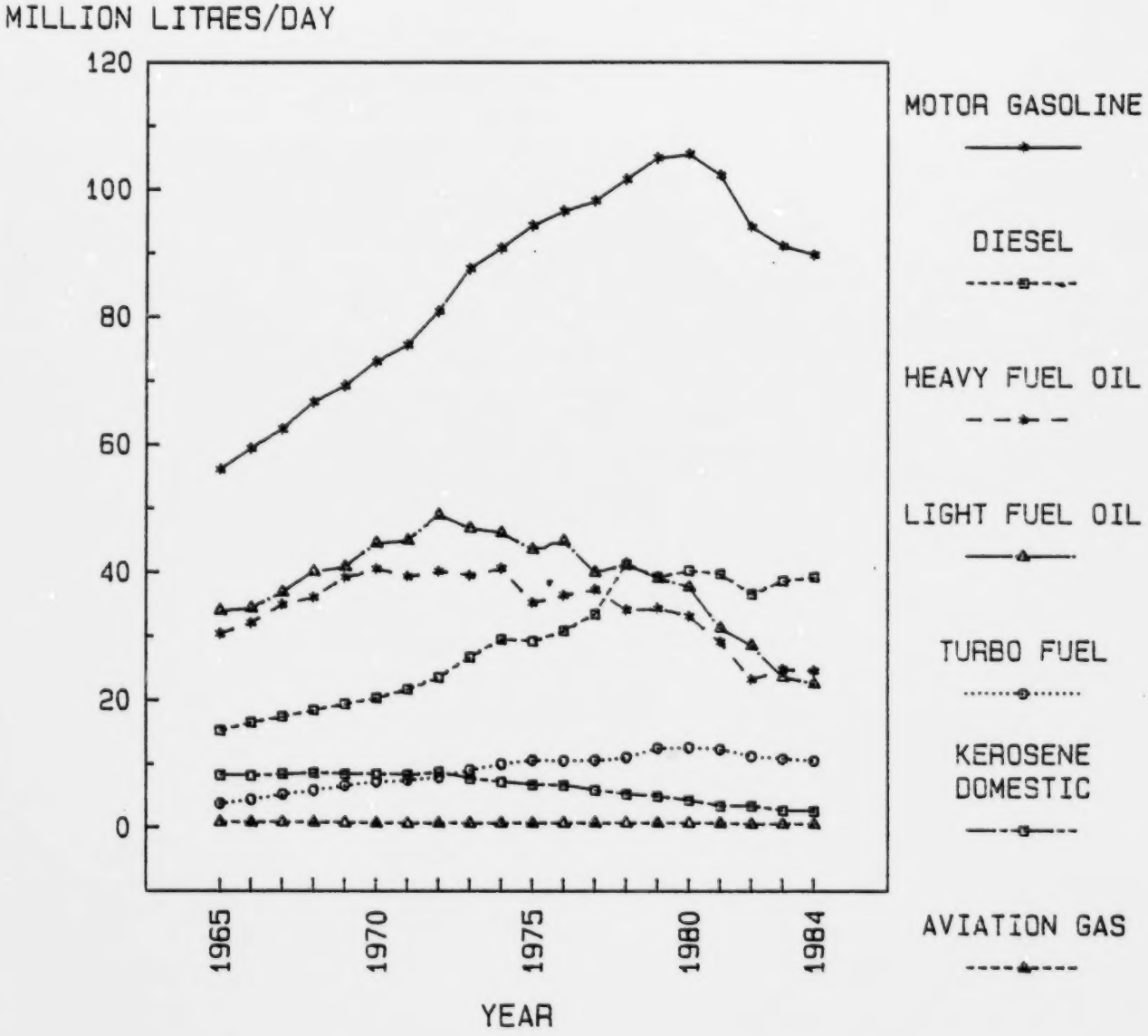
2.1 What Has Been Achieved?

Canada has experienced a dramatic reduction in gasoline demand, as shown in Figure 2. While motor gasoline consumption increased at an average annual rate of 7.7% between 1960 and 1975, it slowed to 2.4% between 1975 and 1980, then actually decreased at an average annual rate of 3.8% from 1980 to 1984.

The continued demand growth after the first oil crisis in 1973 is explained not only by the lead time required by manufacturers to adjust to new oil supply and price conditions, but also by continued economic growth. The second oil shock in 1979 and the subsequent recession combined to reinforce conservation measures and lead to a decrease in gasoline consumption in road transportation.

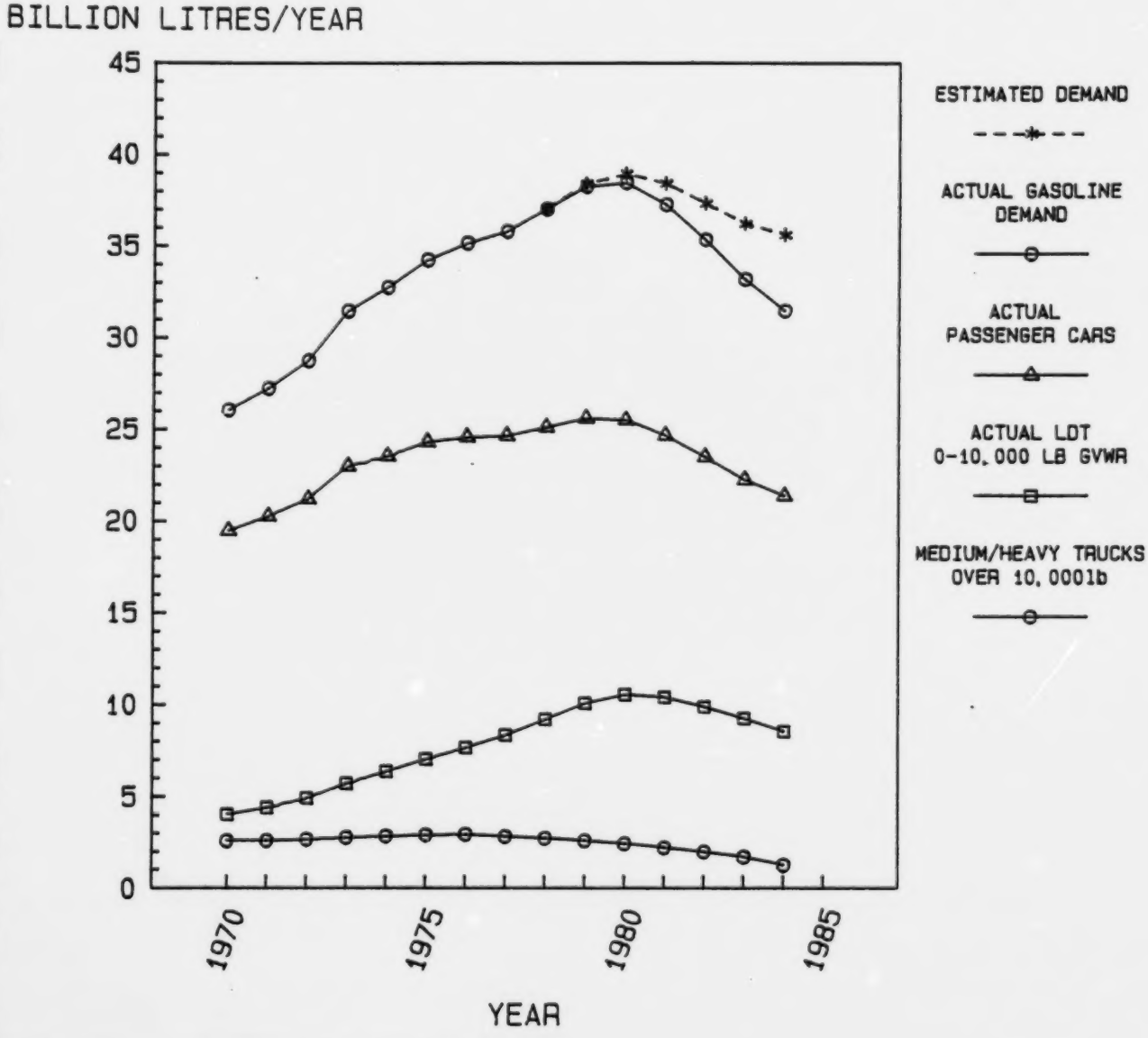
Figure 3, produced with the Transportation Energy Division's fuel demand evaluation model and calibrated with Statistics Canada actual fuel sales, estimates the gasoline consumption which would have occurred (under similar economic conditions) had there been no improvement in the fuel efficiency of light-duty vehicles (only passenger cars and light duty trucks 0-10,000 lbs G.V.W.R.) since 1978.* This scenario analysis suggests that from 1978 to 1984, fuel efficiency improvements have accounted for gasoline savings of 5 million litres** per day.

FIGURE 2
ANNUAL PETROLEUM FUEL DEMAND IN CANADA



SOURCE: EMR/TED

FIGURE 3
ANNUAL MOTOR GASOLINE DEMAND IN CANADA



NOTE: ESTIMATED DEMAND ASSUMES CONSTANT NEW VEHICLE FUEL EFFICIENCY AT 1978 LEVEL

SOURCE: EMR/TED

The data used to prepare Figure 2 can be used to place into perspective the role of light-duty vehicle improvements in reducing the total demand for oil products. From 1978 to 1984, total demand for oil products has decreased by 20% or about 45.7 million litres/day. The components of this reduction are:

- Light Fuel Oil	18.7 million litres/day
- Motor Gasoline	12.0
- Heavy Fuel Oil	9.5
- Kerosene (Domestic)	2.7
- Diesel	2.0
- Turbo Fuel	0.6
- Aviation Gasoline	0.2
- TOTAL	45.7 million litres/day

The significance of the gasoline and light fuel oil reductions are evident.

The improvements in the fuel efficiency of new passenger cars are shown in Figure 4 which tracks the progress in new passenger vehicle fuel consumption for the 1975-1985 period. The 1978-1985 fuel consumption nunmbers are based upon test results provided to the Government of Canada by automobile manufacturers. The 1975-1978 numbers have been generated as estimates by Transport Canada. Fuel consumption has decreased from

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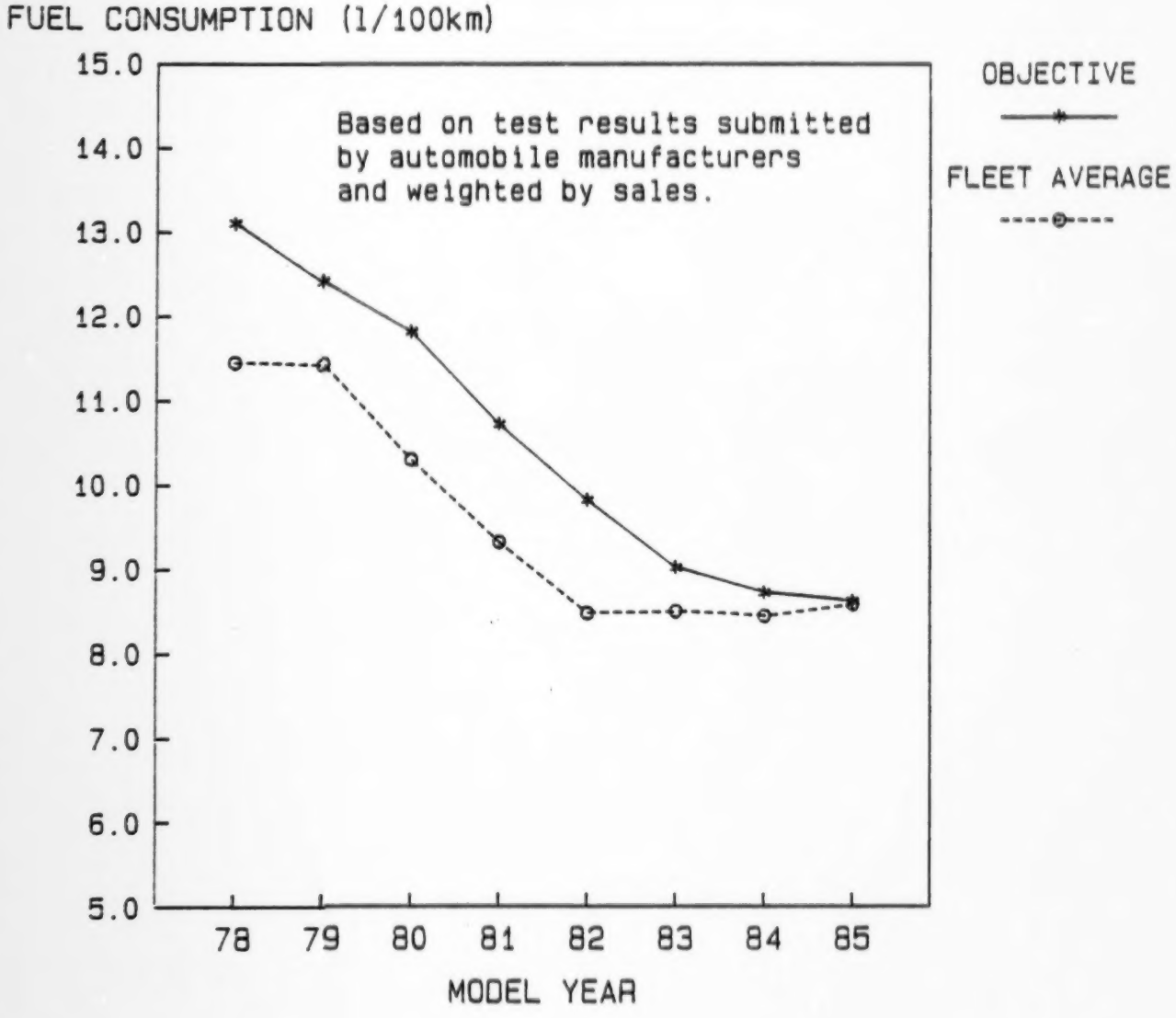
* Estimates generated by the fuel demand evaluation model are a function of historical fleet sizes, distances travelled, on-road fuel consumption by model year, and vehicle survival rates.

** Note concerning units: In this paper SI (metric) units are used whenever practical. In recognition, however, of the widespread use of Imperial Units in automotive fleet analysis in North America, and in deference to the expected large number of American readers, Imperial units have been used where use of SI could significantly compromise the clarity of the discussion.

FIGURE 4
NEW PASSENGER CAR FLEET
FUEL CONSUMPTION VS. OBJECTIVE



NOTE: FUEL CONSUMTIONS ARE COMPARATIVE RATINGS
NOTE: 84 & 85 SALES ARE ESTIMATES ONLY.
SOURCE: EMR/TED

11.4 L/100 km to 8.6 L/100 km or 25% over the eight-year period* or by 44% using 1975 as the base year. For the new passenger fleet as a whole, the average fuel efficiency has surpassed the objectives established under the Motor Vehicle Fuel Economy Program.

In addition to passenger cars, light-duty trucks (LDTs)** are important gasoline consumers, as shown in Figure 3. Sales of LDTs grew dramatically in the 1970's, then dropped almost as dramatically at the end of the decade (Figure 5). In 1984 they accounted for 18% of the total number of light duty vehicles; however, they consumed a disproportionate share of gasoline: approximately 28%.

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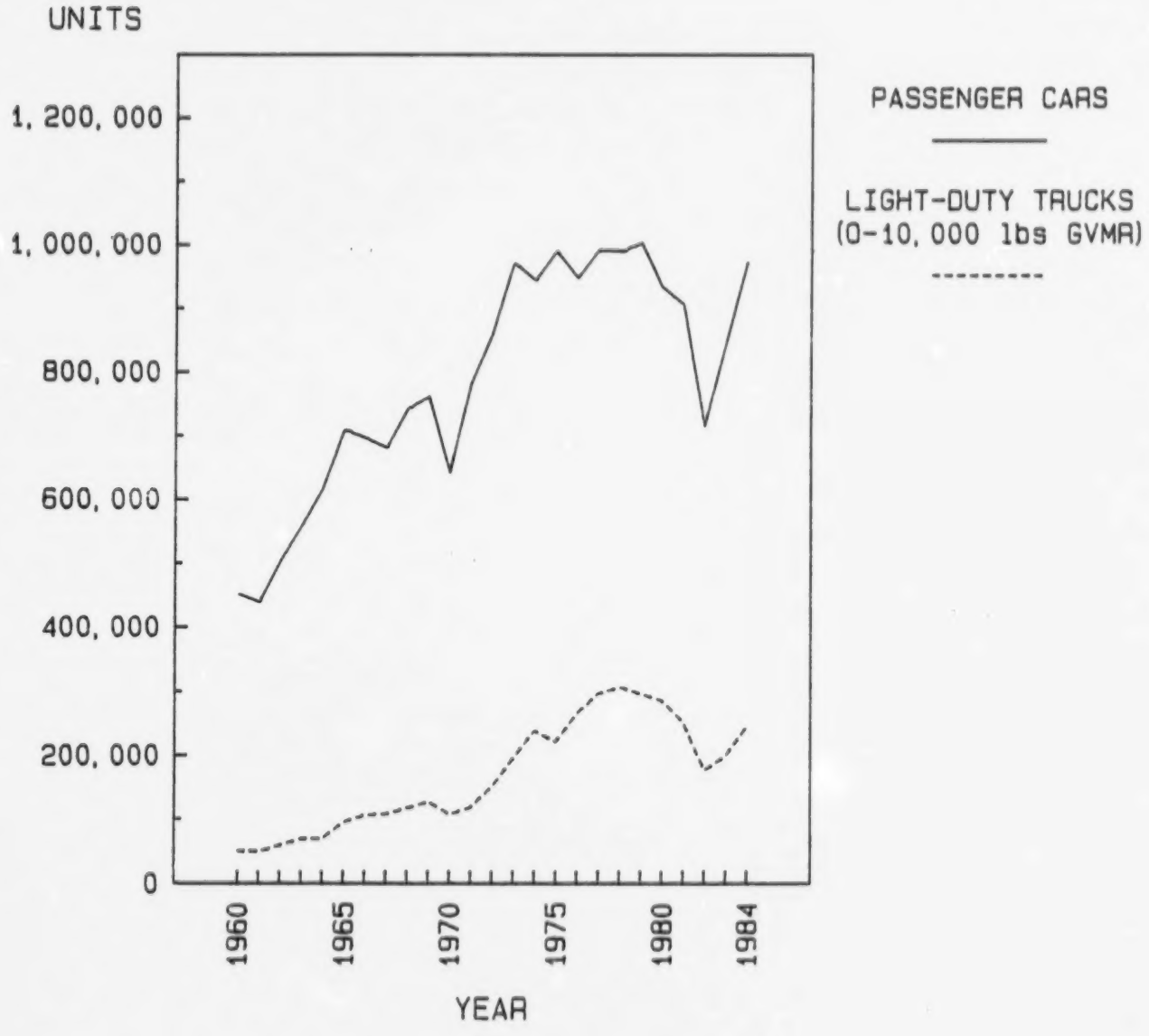
* Unless otherwise specified, all fuel consumption and fuel economy data in this report are based on laboratory test results using government approved test procedures and are the "Comparative Rating." This rating is arrived at by weighing the City and Highway consumption numbers by 55% and 45% respectively. Actual on-road fuel consumption may vary.

** "Light-duty trucks" is a generic vehicle category that includes pick-ups, vans and special purpose vehicles with Gross Vehicle Weight Ratings of 6,000 lbs. or less. In the interest of brevity, the category is referred to by the common acronym LDTs in this report.

FIGURE 5
ANNUAL SALES OF LIGHT-DUTY VEHICLES USING GASOLINE



SOURCE:EMR/TED

Although mandatory fuel economy standards for LDTs are in place in the U.S.A., no objectives have been set for them in Canada. To assist purchasers in selecting the most fuel efficient models, ratings for LDTs are included in the Canadian Fuel Consumption Guide. Figure 6 shows the progress in fuel consumption of LDTs in the 1979-85 period.

The Motor Vehicle Fuel Economy Program test conditions are intended to ensure that all vehicles are tested in an identical fashion so that meaningful comparisons can be made amongst vehicles offered for sale to consumers. Details of the test cycle are included in Appendix II. The actual on-road fuel consumption of vehicles, however, can be higher than the test number, and the difference is highly variable. To account for this degradation, the city test results are conservatively increased by 10% before publishing in the Fuel Consumption Guide (as the Urban Rating) to bring the reported consumption more in line with that experienced by motorists. A similar adjustment of 15% will be made to published highway ratings beginning with 1986 model year *. With these adjustments Canadian consumers will not only be able to compare the fuel efficiency of various models of vehicles produced by competing manufacturers, but will also have a reasonable estimate of the on-road fuel consumption that they can expect to achieve.

An estimate of the on-road fuel consumption trend for the Canadian passenger car population (or fleet) is shown in Figure 7. Although the new car fuel consumption improved by 25% between 1978 and 1985 (as measured in laboratory tests), the average on-road fuel consumption of the entire Canadian passenger car fleet (which includes new and old model year cars), decreased by only an estimated 18%. Even without further new vehicle fuel consumption improvements beyond their current level of efficiency, the average fuel consumption of the entire Canadian fleet

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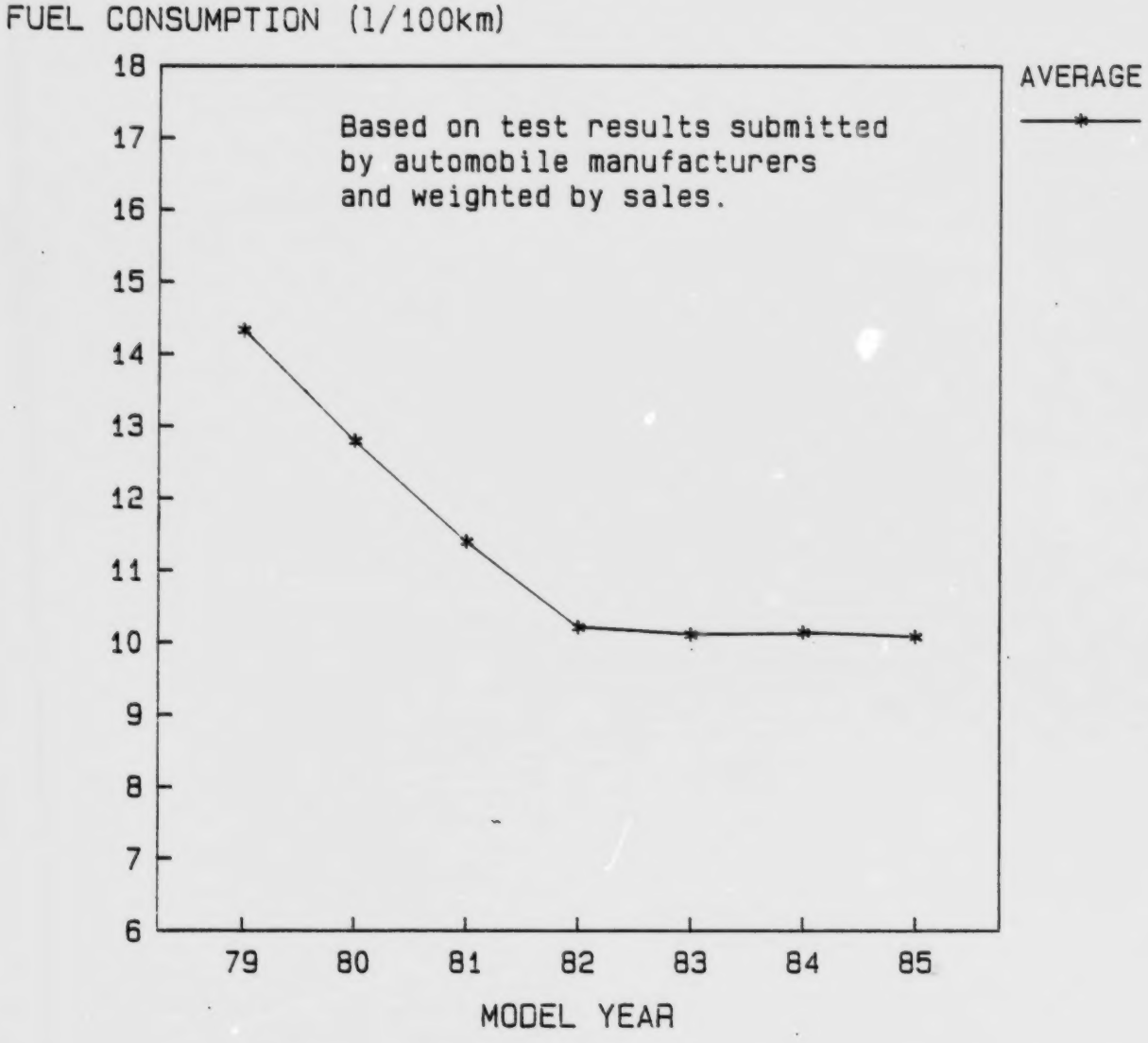
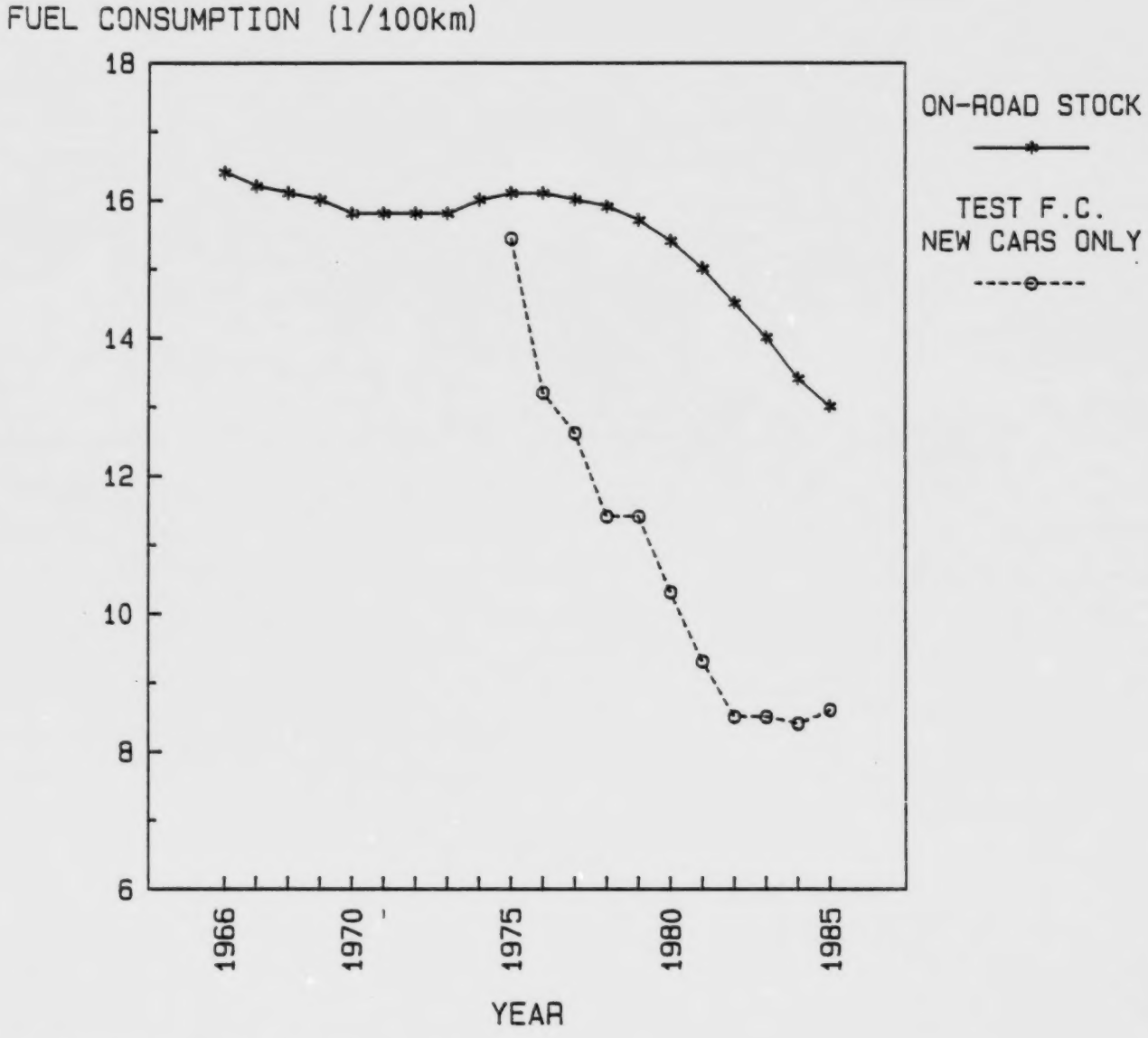
* These correction factors are based upon U.S. M.P.G. fuel economy figures and do not apply to fuel consumption. Adjustments will be carried out with U.S. M.P.G. figures by manufacturers.

FIGURE 6
CANADIAN NEW LIGHT DUTY TRUCKS (LDTs)
FLEET FUEL CONSUMPTION



NOTE: FUEL CONSUMPTIONS ARE COMPARATIVE RATINGS
NOTE: 84 & 85 SALES ARE ESTIMATES ONLY.
SOURCE: EMR/TSD

FIGURE 7
CANADIAN PASSENGER CARS
ESTIMATED FUEL CONSUMPTION



NOTE: ON-ROAD STOCK NUMBERS INCLUDE ALL CARS IN USE
SOURCE: EMR/TED

would likely continue to improve through the replacement of the less fuel efficient older stock by newer, more efficient vehicles. The magnitude of this continuing improvement in the fleet fuel consumption would depend on consumers' purchasing patterns.

Canada's fuel efficiency performance compares favourably with that of the U.S.A. Figure 8 indicates that the Canadian new passenger car fleet has for the most part been slightly more fuel efficient than its U.S. counterpart. Data presented later will show that this improved new vehicle fleet fuel efficiency has resulted primarily from the purchase of smaller, lighter vehicles by Canadians.

In sum, the progress in new vehicle fuel efficiency in the 1978-1985 period in Canada has been equal to or better than that achieved in the U.S.A.

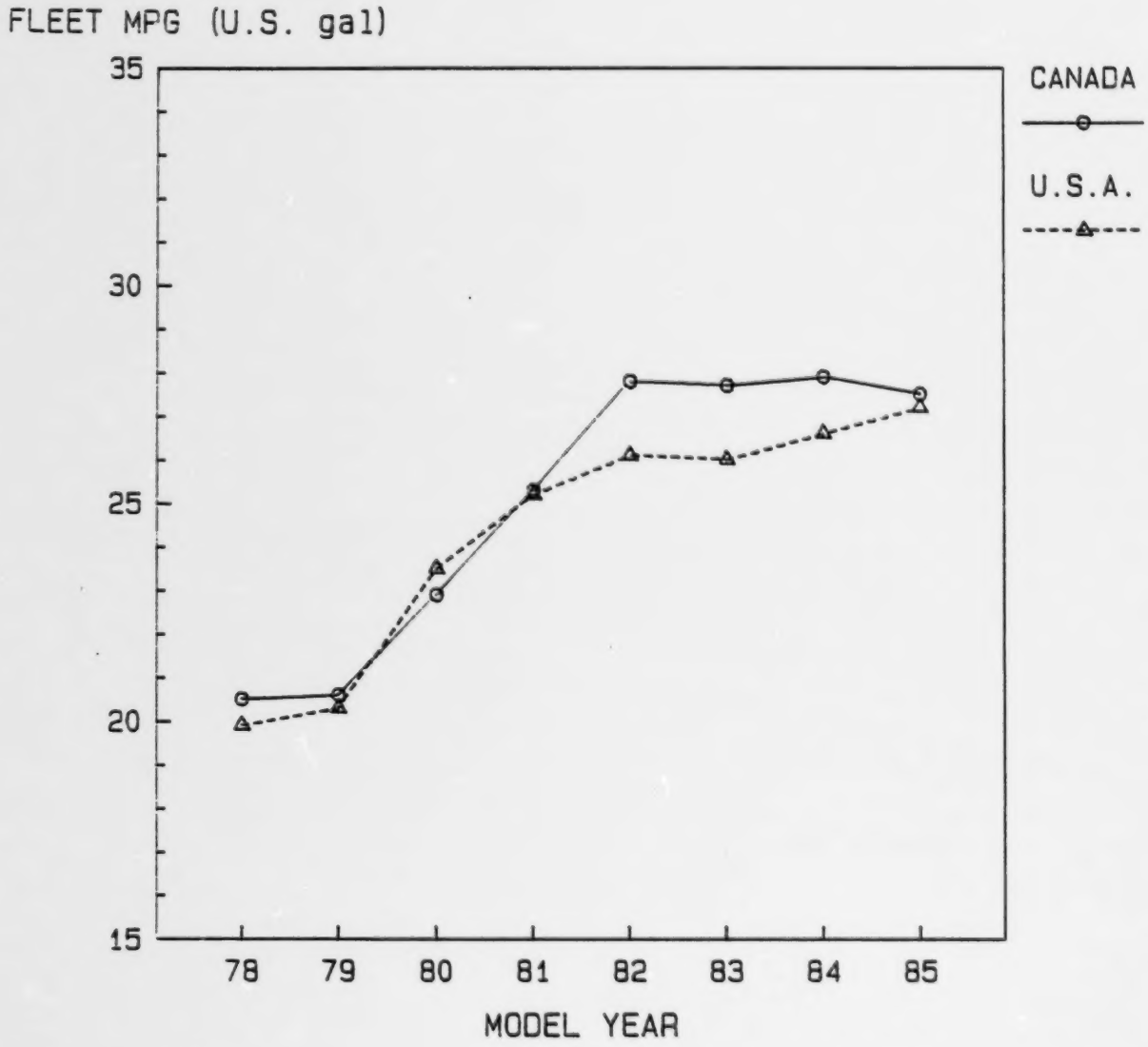
2.2 How Has It Been Achieved?

During the ten-year period 1974 to 1984, North American automobile manufacturers invested heavily in improved technology, product design, and manufacturing processes. These investments were made in response to foreign competition, exhaust emission and safety regulations, fuel economy standards, including as well, consumer demand for a wide choice of efficient high-quality vehicles. Some of these same factors, in addition to general economic conditions, contributed to decreased profitability of the domestic industry during the period in which their investments were required. Having come through this difficult period, the industry is now able to offer consumers more fuel efficient automobiles at competitive prices.

2.2.1 Passenger cars

North American manufacturers made important design changes to their automobile bodies, engines and drivetrains. The objective of their revised body designs was to maintain internal dimensions in the passenger compartment while reducing external dimensions, weight, as well as

FIGURE 8
NEW PASSENGER CAR FLEET MPG
CANADA VS. U.S.A.



NOTE: FUEL CONSUMPTIONS ARE COMPARATIVE RATINGS
SOURCE: EMR/TED, EPA

aerodynamic and rolling resistances. Manufacturers strived, through engine redesign, to improve fuel efficiency, to reduce exhaust emissions, and to provide higher specific-power output. Similarly, drivetrain changes were aimed at reducing weight, reducing frictional losses, and providing more effective matching of engines and gearbox ratios.

2.2.1.1 Fleet weight

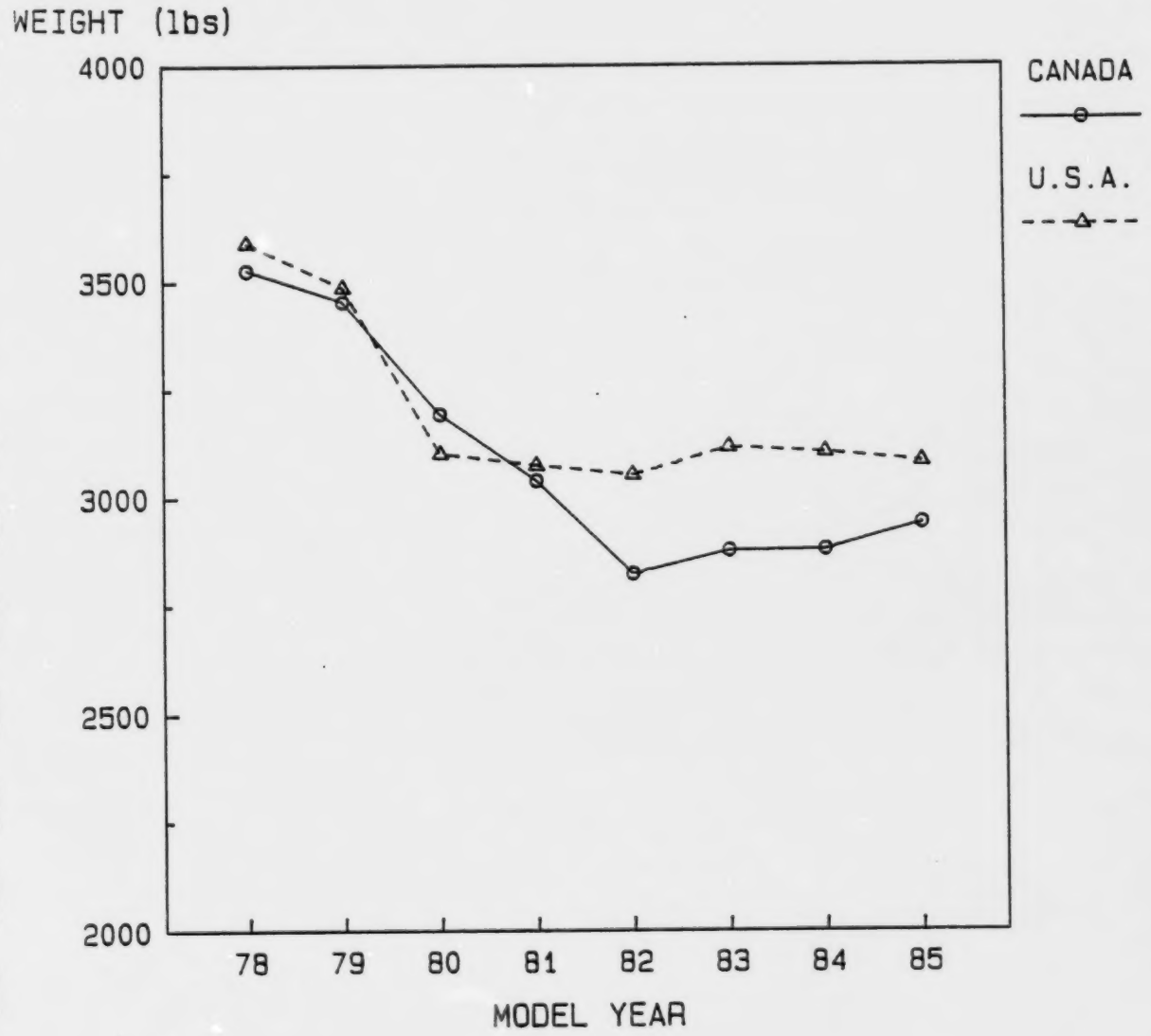
Probably the most significant factor leading to improved fleet fuel efficiency has been the reduction of the new vehicle fleet weight. Figure 9 shows the average new passenger car weight by model year for both Canada and the U.S. for the 1978-1985 period. Average vehicle weight has declined from 3526 lb to 2941 lb in Canada or 17%. The decrease in weight has been greater than that experienced in the U.S.A., with the average weight of 1984 vehicles sold in Canada being 224 lb lower than the U.S. average.

Weight reduction has been accomplished in a variety of ways. For example, materials such as lighter aluminum, plastics, and high-strength steels have replaced conventional steel for many vehicles components.

Front-wheel drive configurations have also led to reduced weight by permitting more space-efficient designs. Figure 10 shows that the percentage of passenger cars using front-wheel drive has increased in Canada from 13% in 1978 to 68% in 1985. The strikingly lower percentage of vehicles having front-wheel drive in the United States is evidence of a difference between consumer preference in the two countries.

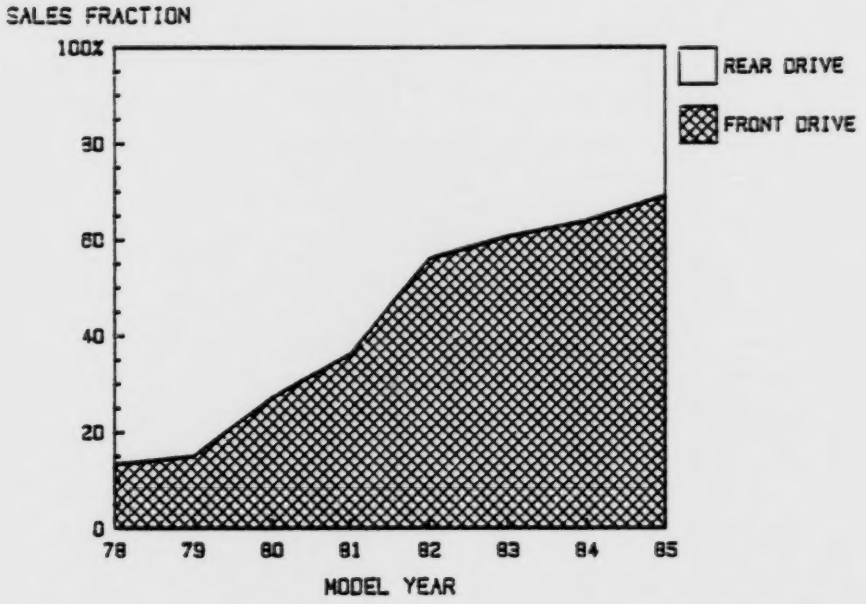
The dramatic reduction in new car fleet weight is well illustrated in Figure 11 which compares sales fraction by weight class for model years 1979, 1981, 1983 and 1985. In 1979, 13% of vehicles sold in Canada were in the 4500-lb weight class, but in 1985 this class accounted for less than 1%. Between 1979 and 1985 the 4000-lb class had been replaced by the 2750-lb class as the largest-selling weight class in Canada.

FIGURE 9
NEW PASSENGER CAR FLEET WEIGHT
CANADA VS. U.S.A.



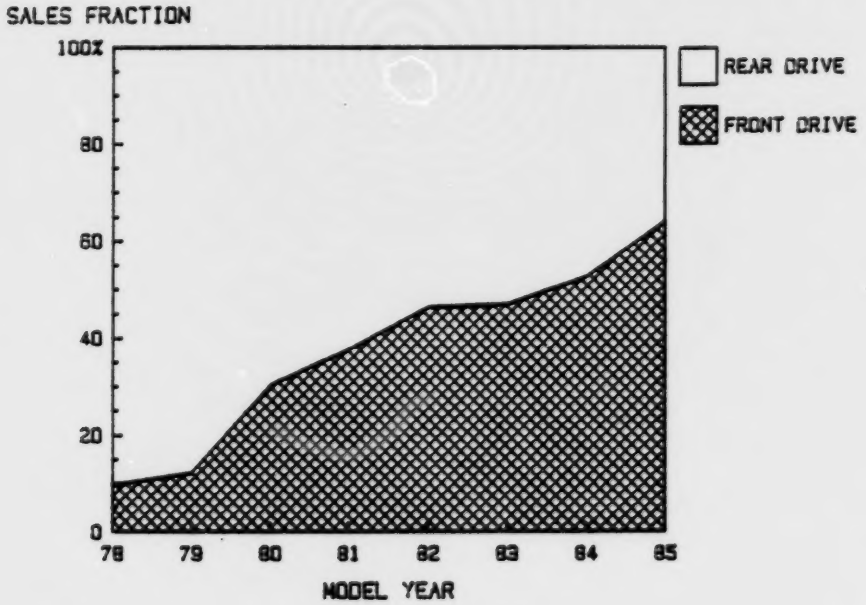
NOTE: WEIGHTS ARE EXPRESSED AS INERTIA WEIGHT CLASS
SOURCE: EMR/TED, EPA

FIGURE 10-A
CANADIAN NEW PASSENGER CARS
(Front vs Rear Wheel Drive)



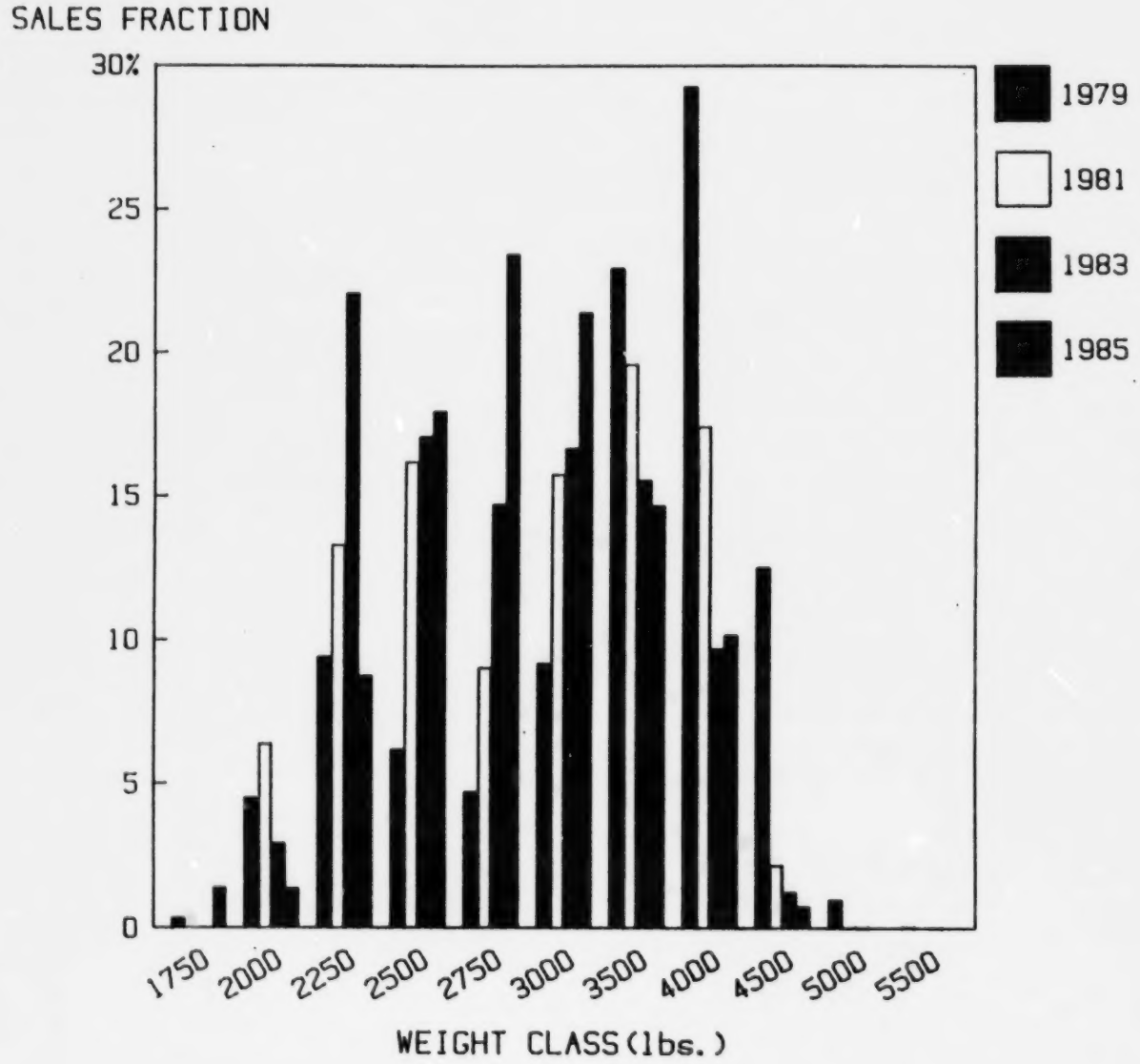
SOURCE: EMR/TED

FIGURE 10-B
AMERICAN NEW PASSENGER CARS
(Front vs Rear Wheel Drive)



SOURCE: EPA

FIGURE 11
CANADIAN NEW PASSENGER CARS
(Weight Distribution)



NOTE: WEIGHTS ARE EXPRESSED AS INERTIA WEIGHT CLASS
SOURCE: EMR/TED

LEAVE BLANK FOR FIGURE 11

Figure 12 compares the average weight of Domestic, European and Asian passenger cars sold in Canada in the 1978-1985 period. The average Domestic vehicle has declined in weight by 700 lb to 3100 lb, while the average European car sold in Canada has increased in weight by almost 250 lb to 2700 lb. The average weight of Asian cars has remained relatively constant, with a slight increase in the past three years.

Studies carried out in the United States indicate that weight reduction accounts for 26% of the fuel efficiency improvements achieved since 1975. It is expected that a similar figure would apply to Canada.

There has also been a shift by consumers to smaller cars (as measured by interior volume) illustrated in Figure 13, which shows the percentage of total new vehicle sales in Canada by Environmental Protection Agency size class.

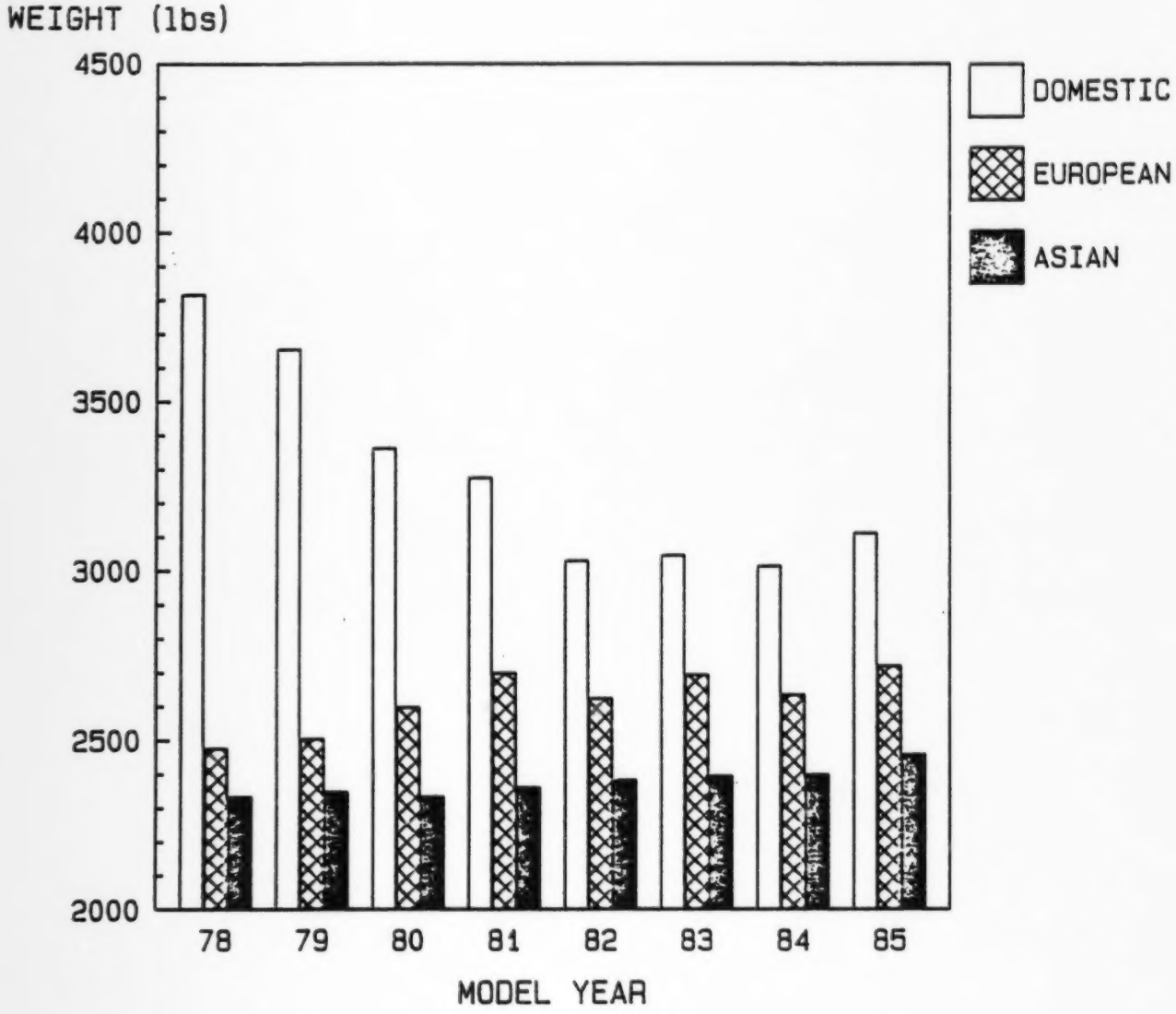
2.2.1.2 Transmissions

Efficiency improvements in transmissions have been achieved by many automobile manufacturers through the incorporation of new features such as torque converter lock-up (TCLU), four-speed automatics, five-speed manuals, overdrive and optimized gear ratios. Consumers have opted for more efficient transportation by increasing their purchase of manual transmission equipped vehicles from 21% in 1978 to almost 30% in 1985 as shown in Figure 14-A. On average a vehicle equipped with a manual transmission achieves 5-10% better fuel economy than a similar vehicle equipped with an automatic transmission. This change in consumer preference has resulted in a distinct improvement in overall new vehicle fleet fuel consumption. Figure 14-B illustrates transmission use in the American fleet.

2.2.1.3 Fuel Systems

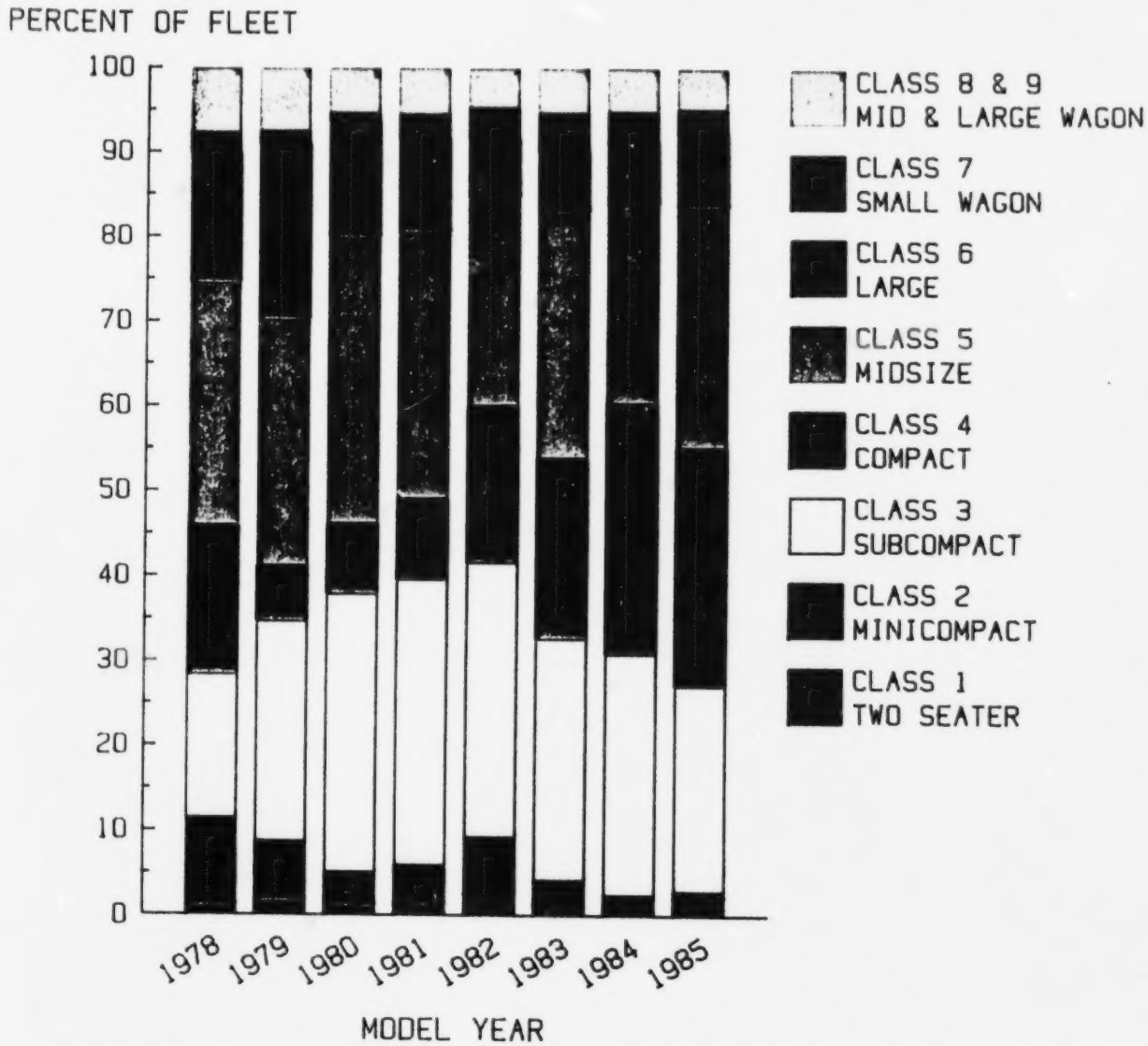
Fuel injection, when accompanied by electronic engine controls, results in improved fuel efficiency (through more precise air/fuel ratio control and delivery to cylinders). Figure 15-A shows that fuel injection has increased on Canadian sold passenger cars from 3% in 1978 to 33% in 1985 with the most significant

FIGURE 12
CANADIAN NEW PASSENGER CAR WEIGHT
DOMESTIC, EUROPEAN, AND ASIAN SUBFLEETS



NOTE: WEIGHTS ARE EXPRESSED AS INERTIA WEIGHT CLASS
SOURCE: EMR/TED

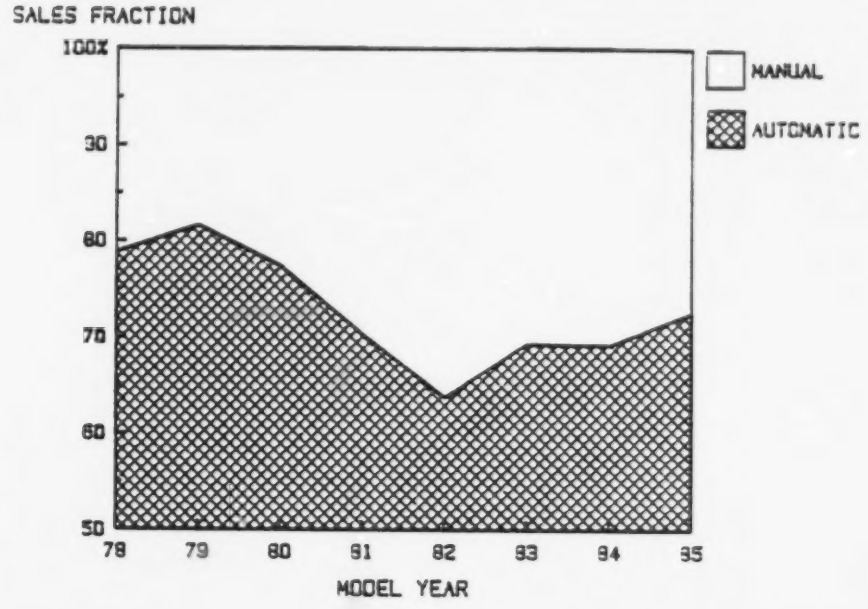
FIGURE 13
CANADIAN NEW PASSENGER CARS
SALES DISTRIBUTION BY EPA SIZE CLASS



SOURCE: EMR/TED

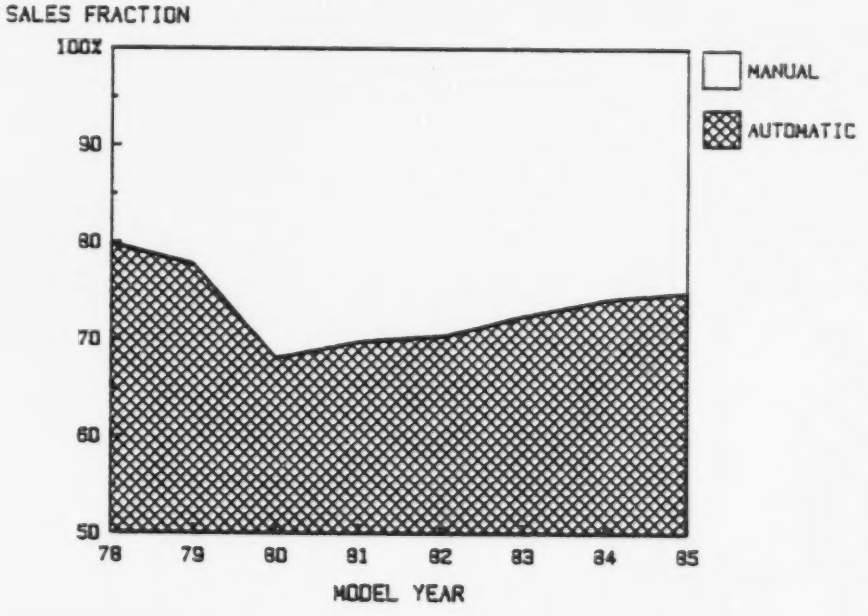
LEAVE BLANK FOR FIGURE 13

FIGURE 14-A
CANADIAN NEW PASSENGER CARS
(Auto vs. Manual Transmission)



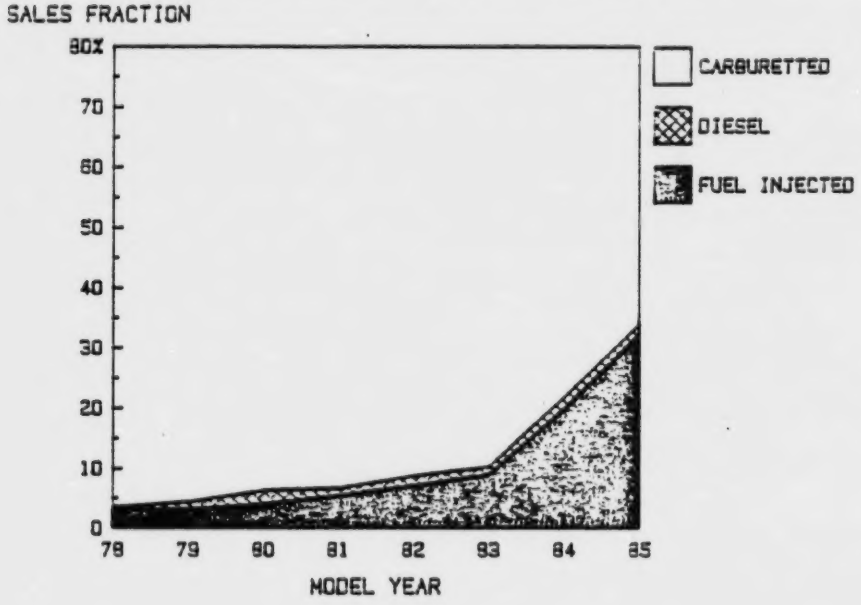
SOURCE: EMR/TED

FIGURE 14-B
AMERICAN NEW PASSENGER CARS
(Auto vs. Manual Transmission)



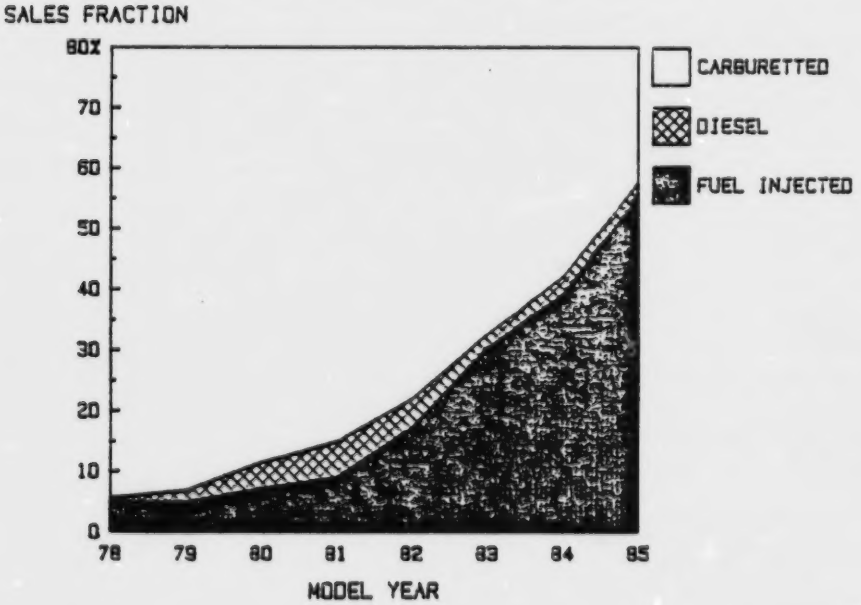
SOURCE: EPA

FIGURE 15-A
CANADIAN NEW PASSENGER CARS
(Carb., Fuel Injected and Diesel)



SOURCE: EMR/TED

FIGURE 15-B
AMERICAN NEW PASSENGER CARS
(Carb., Fuel Injected and Diesel)



SOURCE: EPA

increase occuring in the 83/85 period. The experience in the U.S. is more dramatic. Figure 15-B shows that 1985 U.S. fuel injection penetration in new passenger cars reached 55%. The less stringent Canadian emission standards and the shortage of components for subcompact and compact cars are thought to be the main reasons for the lower use by manufacturers of fuel injection in Canada. The data indicate, however, that a rapid increase in fuel injection use is taking place in both countries.

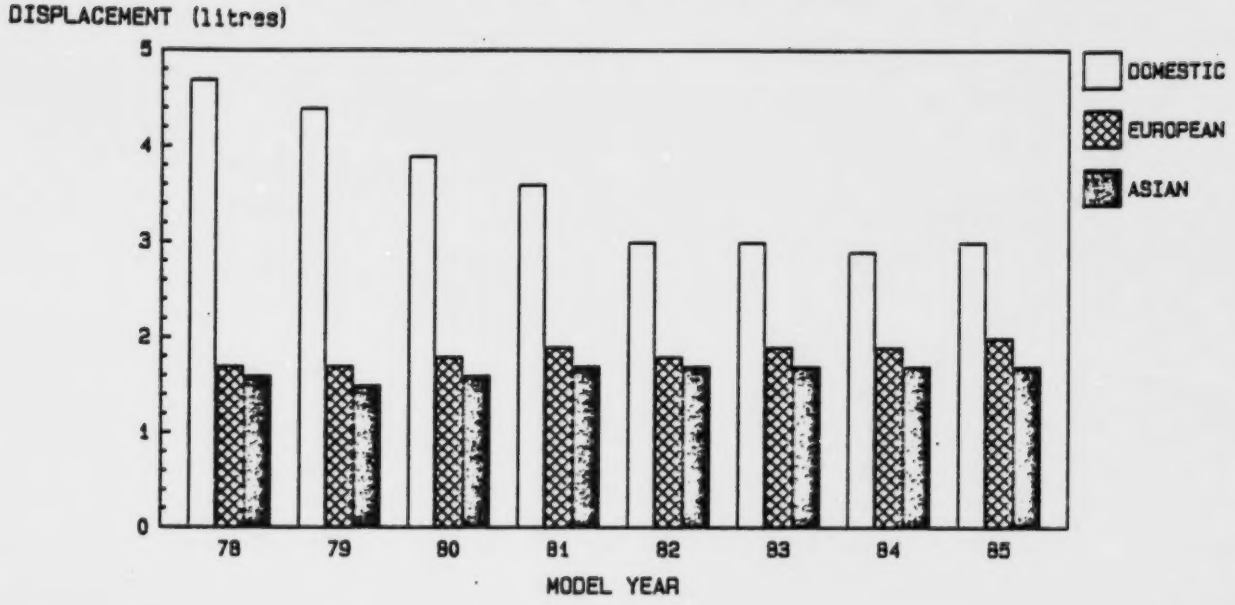
2.2.1.4 Engine size and weight

Engine size reductions (expressed in terms of displacement) can be directly linked to vehicle weight reductions. Lighter vehicles perform well with smaller, lighter engines. This further reduces overall vehicle weight. For Domestic cars sold in Canada, the average engine displacement has decreased from 4.7 L in 1978 to 3.0 L in 1985. For foreign vehicles, slight increases in engine size have occurred during the same period. These trends are shown in Fig. 16-A

In addition to the engine size reductions that accompany the increased sales of smaller cars, more smaller engines are now being installed in cars of a given size than was traditionally true in the past. This is illustrated by the fact that the ratio of engine displacement to vehicle weight has been decreasing. Figure 17-A indicates that most reductions in engine size for a given weight of vehicle have been made by domestic manufacturers. A 21% decrease for the domestics has no doubt improved fuel efficiency. Any loss in vehicle performance is gradually being offset by the introduction of new technologies such as turbocharging that boost the performance of engines (when demanded by the driver), yet still maintain good fuel efficiency during normal operation.

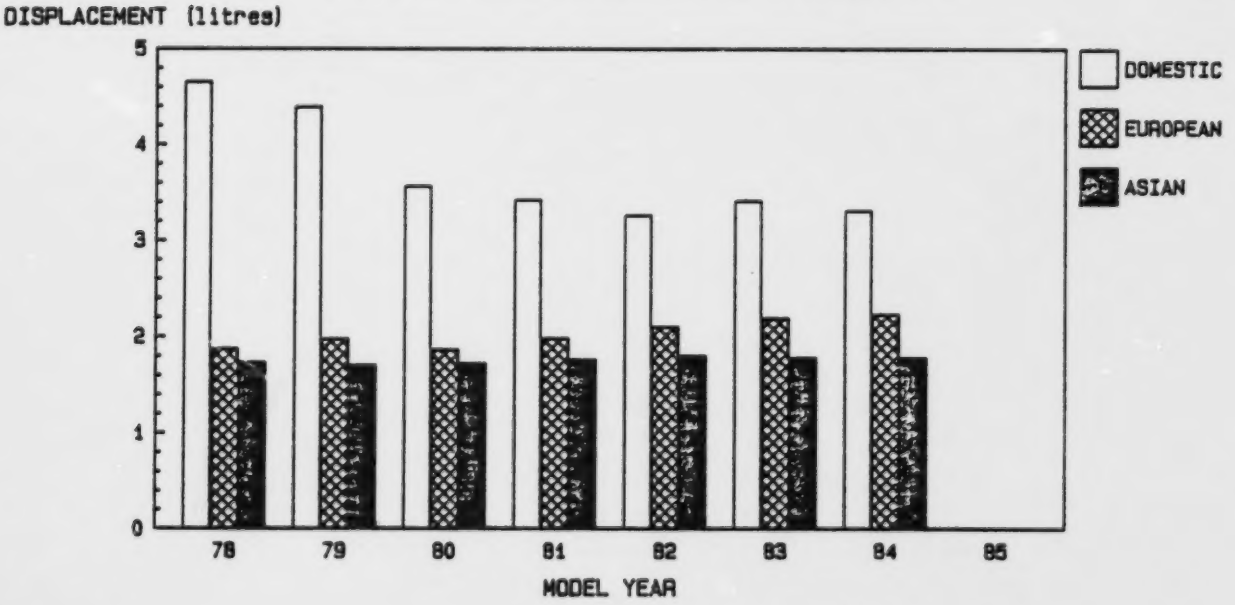
In the U.S.A. the same trend to reduced engine displacement and engine displacement/weight ratio has occurred, as shown in Figures 16-B and 17-B. The reductions up to 1984 have been more modest in the U.S.A. (displacement reduction of 29% vs 37% in Canada). By 1984, average

FIGURE 16-A
CANADIAN NEW PASSENGER CARS
(Engine Displacement by Subfleets)



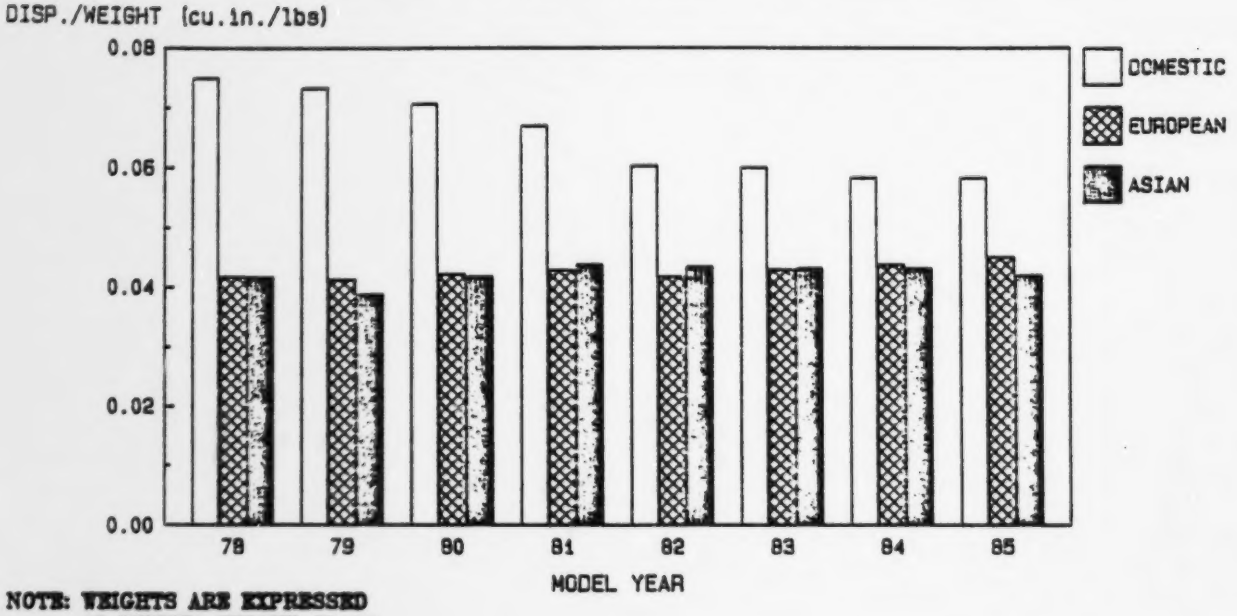
SOURCE: EMR/TED

FIGURE 16-B
AMERICAN NEW PASSENGER CARS
(Engine Displacement by Subfleets)



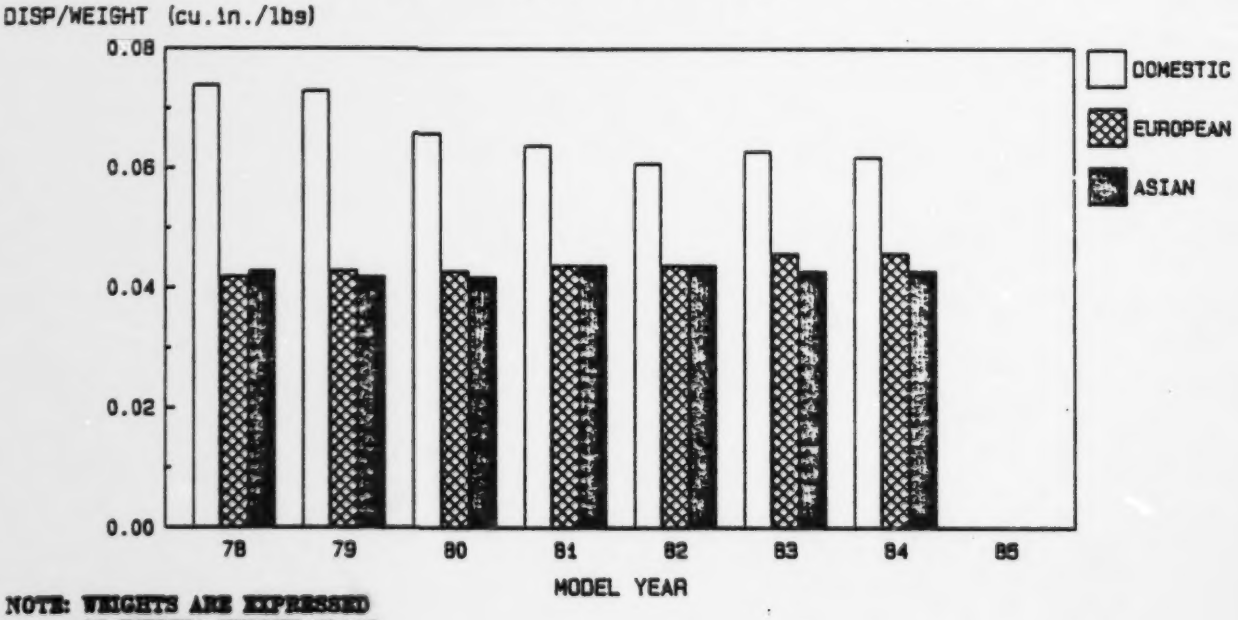
SOURCE: EPA

FIGURE17-A
CANADIAN NEW PASSENGER CARS
(Engine Disp./Wt. Ratio by Subfleets)



NOTE: WEIGHTS ARE EXPRESSED AS INERTIA WEIGHT CLASS
SOURCE: EMR/TED

FIGURE 17-B
AMERICAN NEW PASSENGER CARS
(Engine Disp./Wt. Ratio by Subfleets)



NOTE: WEIGHTS ARE EXPRESSED AS INERTIA WEIGHT CLASS
SOURCE: EPA

engine displacement in Canada was 11% lower than in the U.S.A. This is consistent with trends in the average weight of vehicles. In Canada the 1984 average new car was 7% lighter than that in the United States.

2.2.1.5 Diesels

Figure 15-A illustrates the use of diesel engines in passenger cars sold in the 1978-1985 period. Although diesel use in European vehicles increased from 9% in 1978 to 21% in 1985, Asian and Domestic vehicles have experienced no significant change. Overall diesel passenger car sales increased from 0.6% of total sales in 1978 to 2.0% in 1985. The large market penetration ratio of diesel-powered passenger cars that many anticipated in the late 1970's has not materialized.

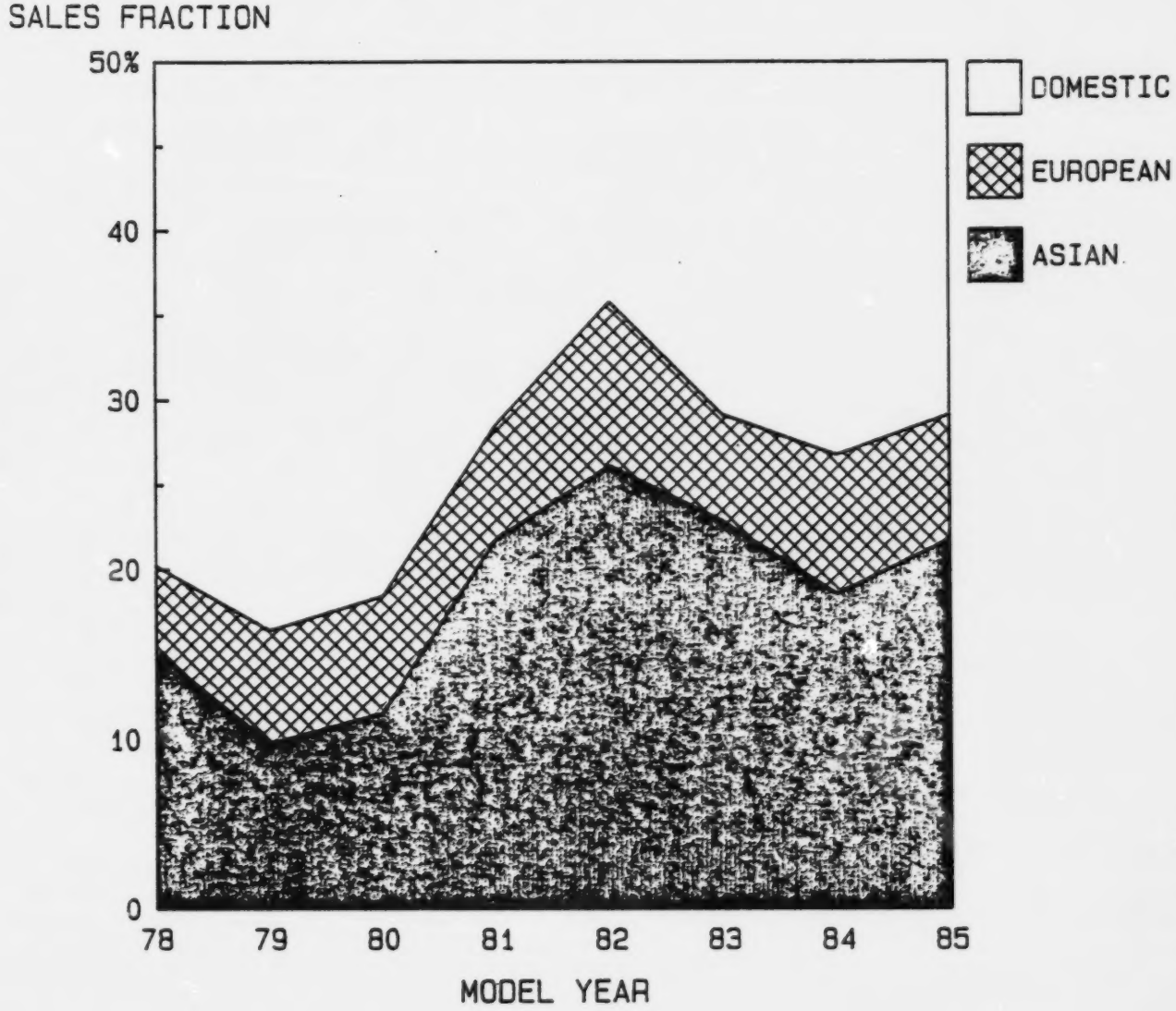
2.2.1.6 Domestic and foreign trends

Total passenger car sales (shown in Figure 5) peaked in 1979 at about one million units. By 1982 sales had declined to 700,000 units and although year to year sales growth increases have been dramatic since 1982, total 1984 sales are anticipated to reach 960,000.

Foreign manufacturers have increased their market share from 20% in 1978 to almost 30% in 1985 (Figure 18). The 1985 share might have been much higher were it not for voluntary export restraints applied to Japanese imports beginning in 1982.

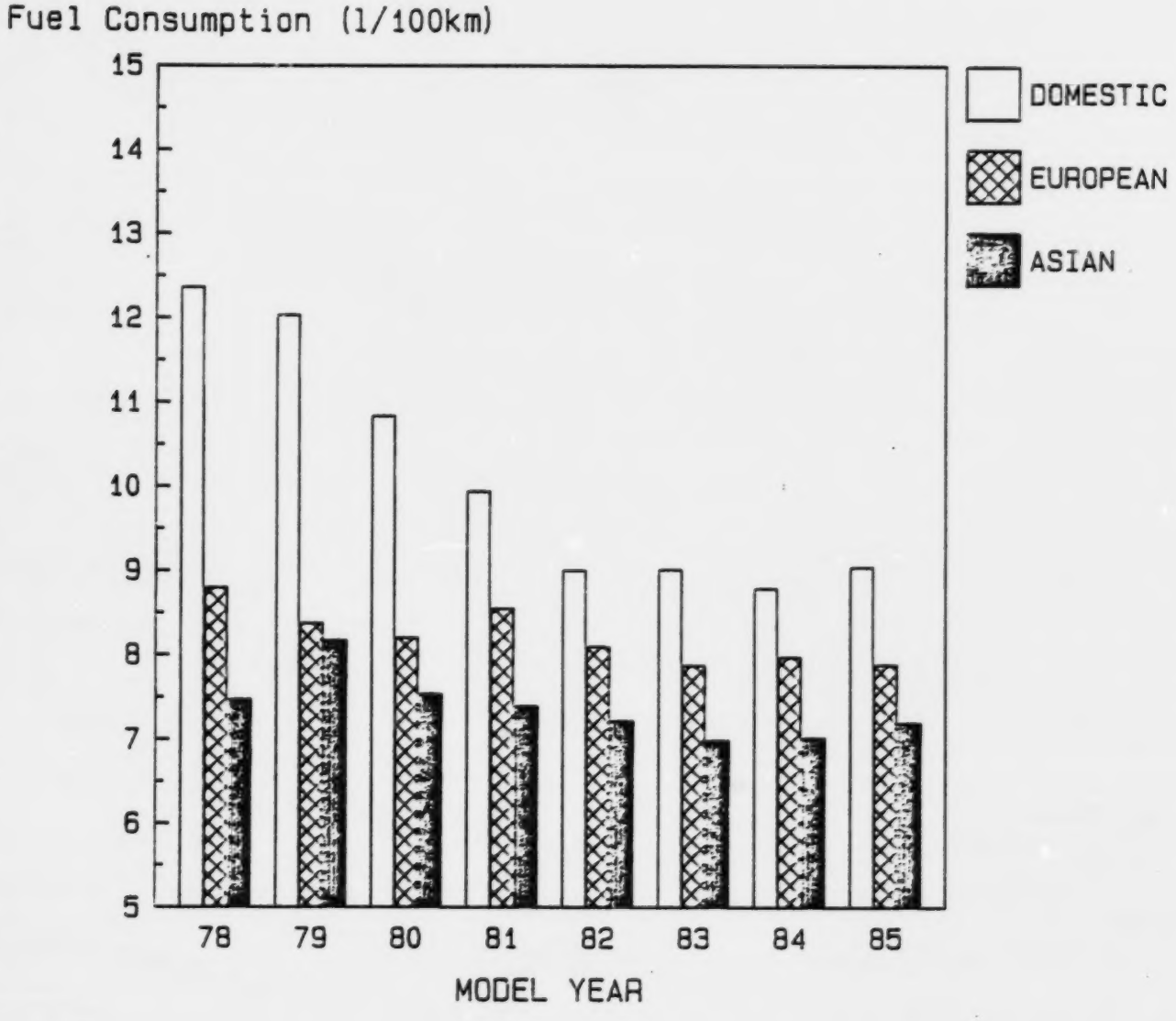
Market shares aside, the improvements in new vehicle fuel consumption are largely attributable to actions by Domestic manufacturers as shown in Figure 19. The average test fuel consumption for Domestic passenger cars has improved from 12.4 to 9.1 L/100 km over the last 7 years, a 27% improvement. The reduction in fuel consumption for European cars has been 10% and 4% for Asian cars. Voluntary export restraints have led Japanese manufacturers to market larger, luxury type vehicles explaining to some degree why their fuel efficiency improvements have been more modest.

FIGURE 18
CANADIAN NEW PASSENGER CARS
(Sales Distribution by Subfleets)



SOURCE: EMR/TED

FIGURE 19
CANADIAN NEW PASSENGER CARS
(Fuel Consumption by Subfleets)



NOTE: FUEL CONSUMPTIONS ARE COMPARATIVE RATINGS
SOURCE: EMR/TED

A final point of interest is a comparison between Domestic and Foreign passenger cars of similar weight. Figure 20 indicates that 1985 domestic cars compared favourably with European and Asian vehicles in terms of fuel consumption for any given weight class.

2.2.2 Light-Duty Trucks (LDT's) (0-6,000 lbs GVWR)*

Since 1979 light-duty trucks, including pick-ups, vans and special purpose vehicles (SPVs), have been included in the Fuel Consumption Guide. Manufacturers have also been affixing fuel consumption labels to light-duty trucks in the same manner as passenger cars.

Manufacturers in Canada provide data only for vehicles in the 0-6000 pound gross vehicle weight class rather than 0-8500 pounds as is done in the U.S.A. As a segregation of the U.S. data was not available, no direct comparisons between the Canadian and U.S. LDT fleets are included in this paper.

2.2.2.1 Fleet weight

As with passenger cars, one of the more significant factors leading to improved fleet fuel efficiency has been a substantial reduction in the average weight of the light-duty truck fleet. In 1979 the average vehicle weight was 4146 pounds. In 1983 this figure had dropped to 3331 pounds, a reduction of 20% (compared with 18% for passenger cars). During this same time period the average fuel consumption improved by 29%. For 1984 and 1985, average weight increased slightly, but average fuel consumption remained unchanged. Details are shown in Figure 21.

The reduction in vehicle weight has been achieved in a similar manner to that employed for passenger cars. The introduction of new downsized vehicles (e.g. GM S-10,15 and Ford Ranger Pick-ups), material substitution, and the emergence of new manufacturers such as Suzuki and Mazda in the small light-duty truck market, have all contributed to the reduction in fleet average weight.

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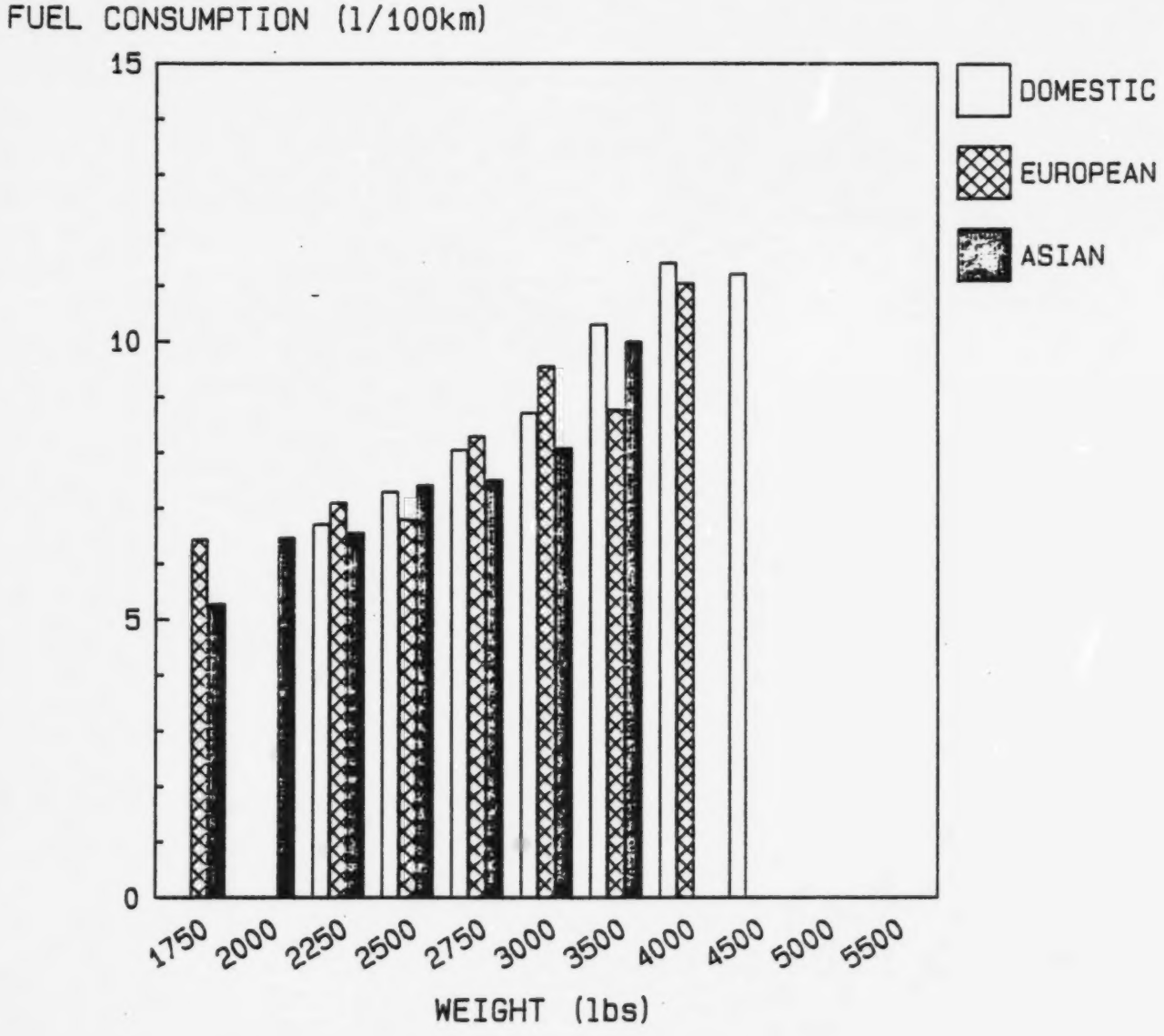
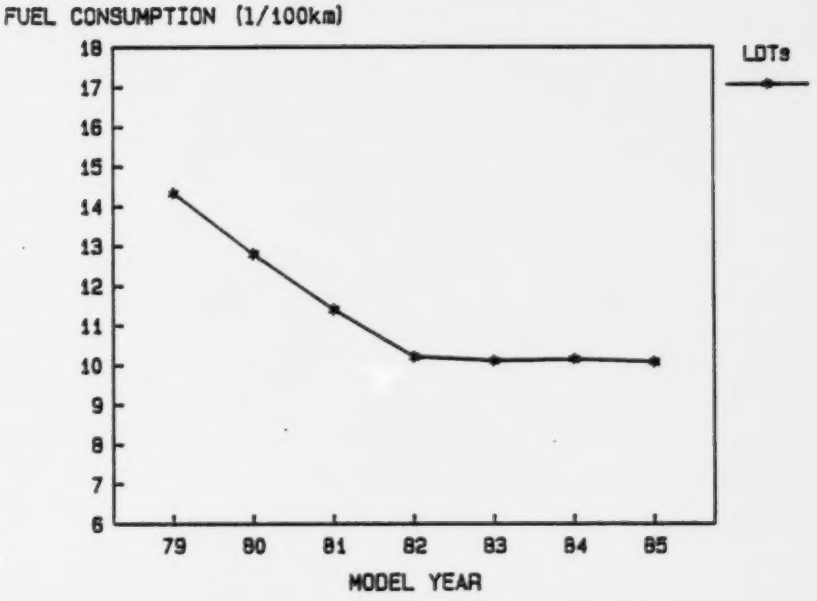
* For a definition of this category see page 10.

FIGURE 20
CANADIAN 1985 NEW PASSENGER CARS
(Fuel Consumption by Weight and Subfleet)



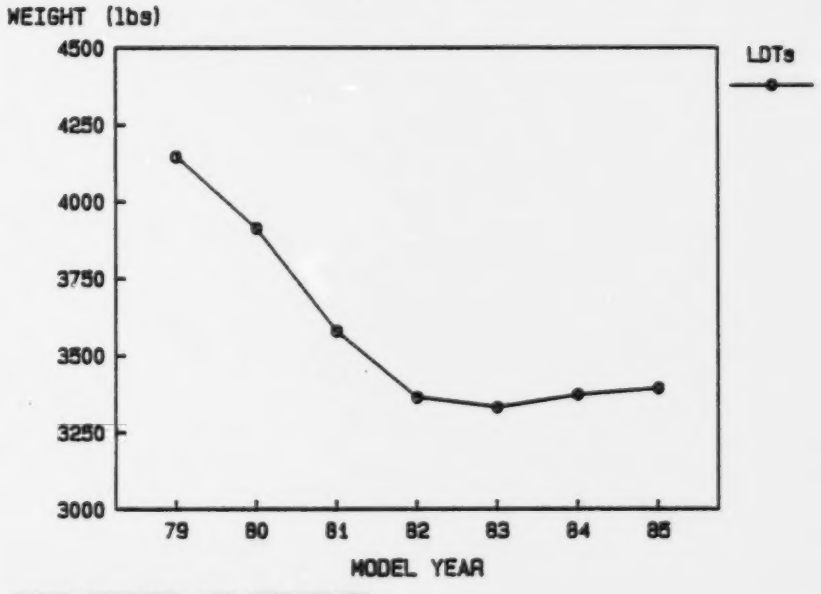
NOTE: WEIGHTS ARE EXPRESSED AS INERTIA WEIGHT CLASS
SOURCE: EMR/TED

FIGURE 21-A
CANADIAN NEW LDT FLEET
(Fuel Consumption)



NOTE:FUEL CONSUMPTIONS ARE COMPARATIVE RATINGS
SOURCE: EMR/TED

FIGURE 21-B
CANADIAN NEW LDT FLEET
(Weight)



NOTE: WEIGHTS ARE EXPRESSED AS INERTIA WEIGHT CLASS
SOURCE: EMR/TED

The large reduction in average LDT weight was also assisted by changes in consumer buying patterns. In 1979 vans represented 26% of the LDT market with an average weight of 4346 pounds (see Figures 22 and 23). Also in 1979, SPVs accounted for only 1.7% of the market, weighing on average, 2893 pounds. By 1983, the SPV's market share had grown to 26.2% of the LDT market, with an average weight of 3296 pounds, while vans made up only 7.7% of LDT sales and had an average weight of 4172 pounds. In this same time frame the pick-up market share shrunk slightly, but the pick-ups' average weight was cut 21% from 4103 pounds to 3247. Vans have been the last area of the light-duty truck segment that manufacturers have addressed in their downsizing programs.

The fleet weight reductions noted for light-duty trucks can almost be entirely attributed to weight reductions in the pick-up segment and a shift away from vans to SPV's. In 1984, the SPV segment has continued to grow but 1985 sales projections show the effect that the new General Motor's "mini-vans" are expected to have on the SPV market.

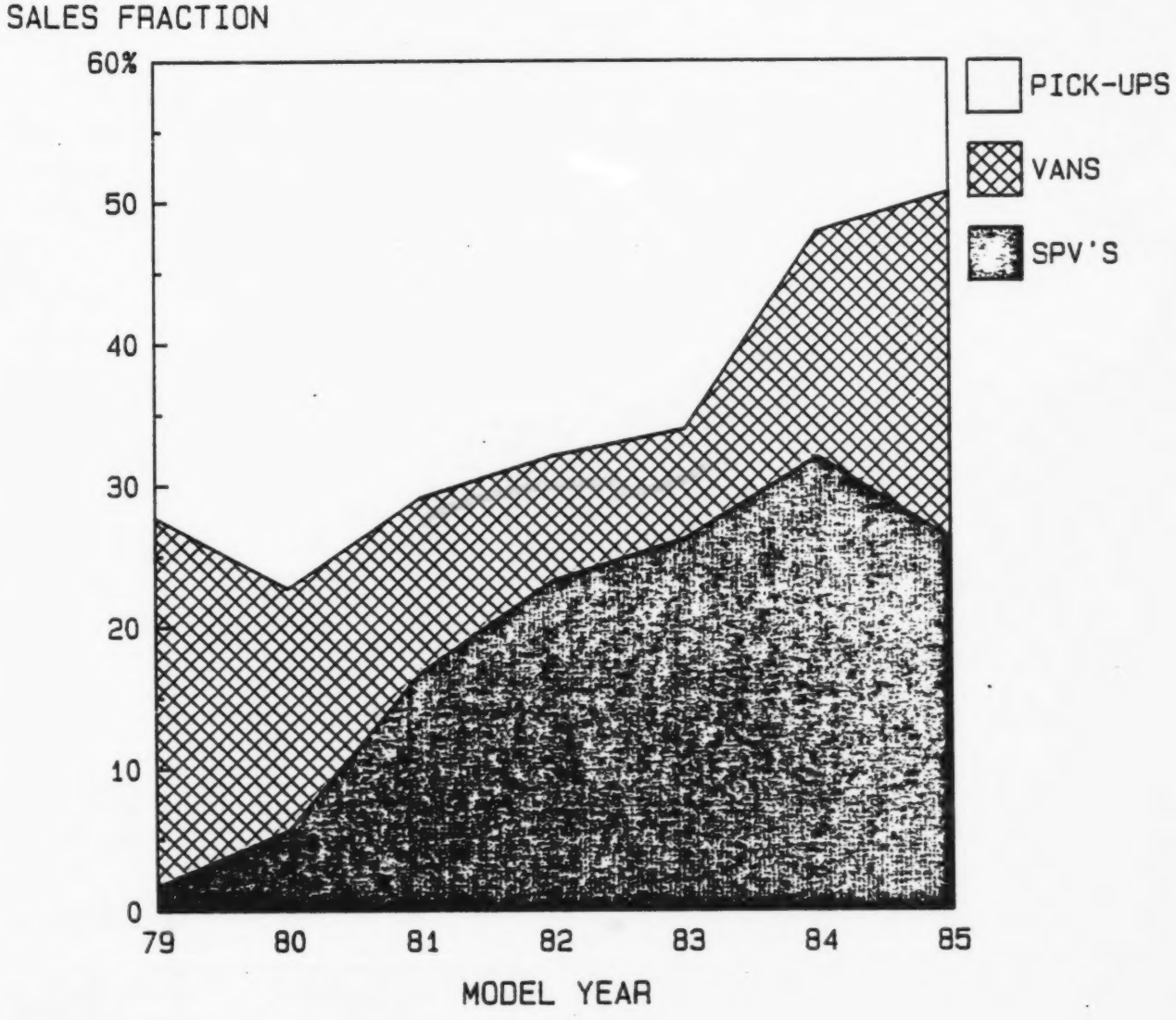
In the most recent 3 model years, vans have had a substantial reduction in average weight (from 4172 pounds in 1983 to 3400 pounds in 1984) and their market share has increased to 20%. This change reflects the introduction and success of Chrysler's 1984 mini-van. When General Motors and Ford introduce their new mini-vans in 1985, the fuel consumption of light-duty trucks should be further reduced.

2.2.2.2 Transmissions

The light-duty truck class has historically been dominated by automatic transmissions. In 1979, 74.5% of the light-duty trucks were delivered with automatics. By 1982 this figure dropped to 42%, but it rose to 51% in 1985 (Figure 24).

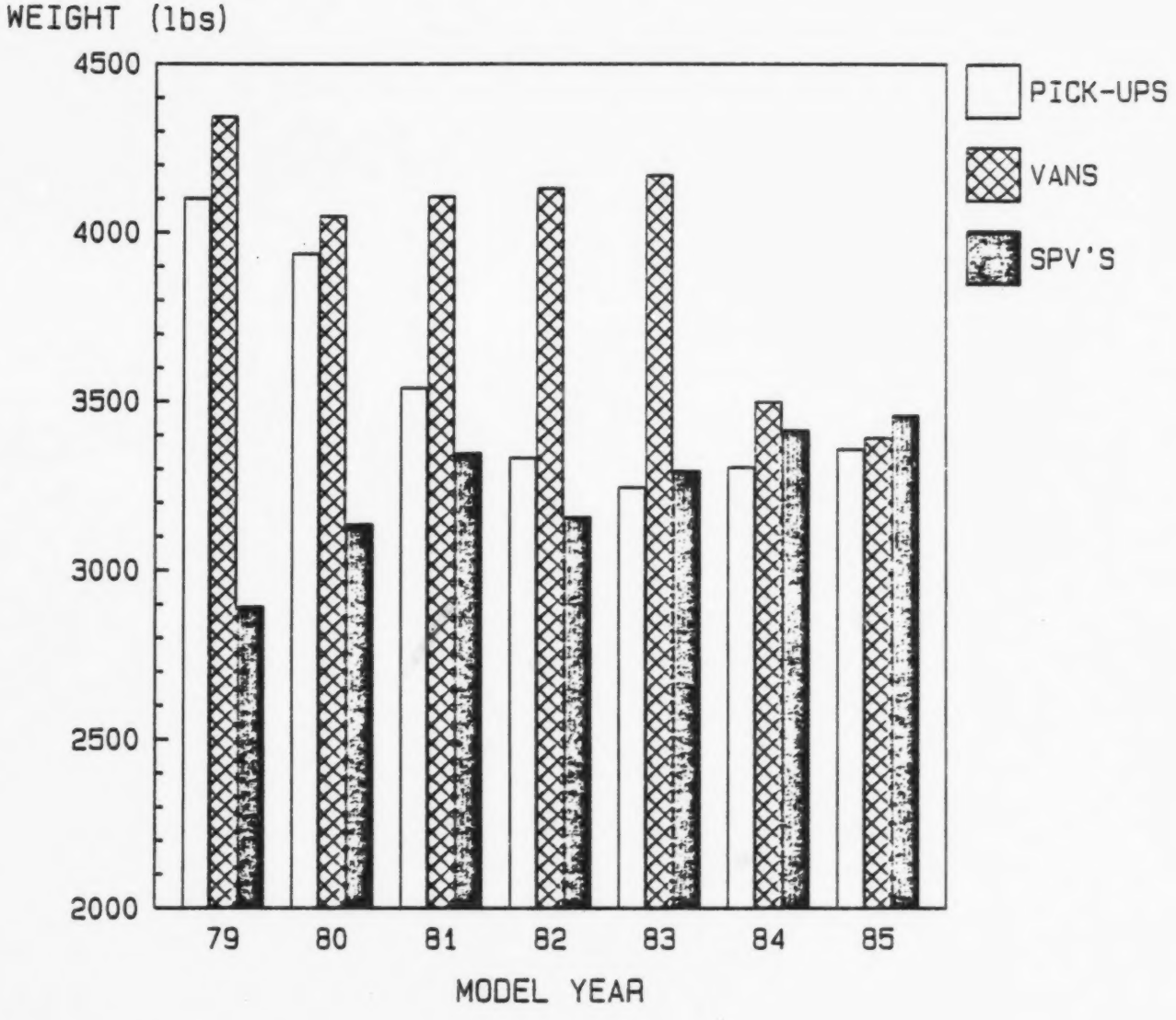
Within the automatic transmission category technological change has taken place. In model year 1979, 6.0% of vehicles built with automatic transmissions utilized torque converter lock-up, while 68.5% employed a conventional torque converter. In model year 1985, the situation has changed. Conventional automatic transmissions accounted for 18.1% (a reduction of 74%), while torque converter lock-up with overdrive

FIGURE 22
CANADIAN NEW LDT FLEET
(Sales Distribution by Subfleets)



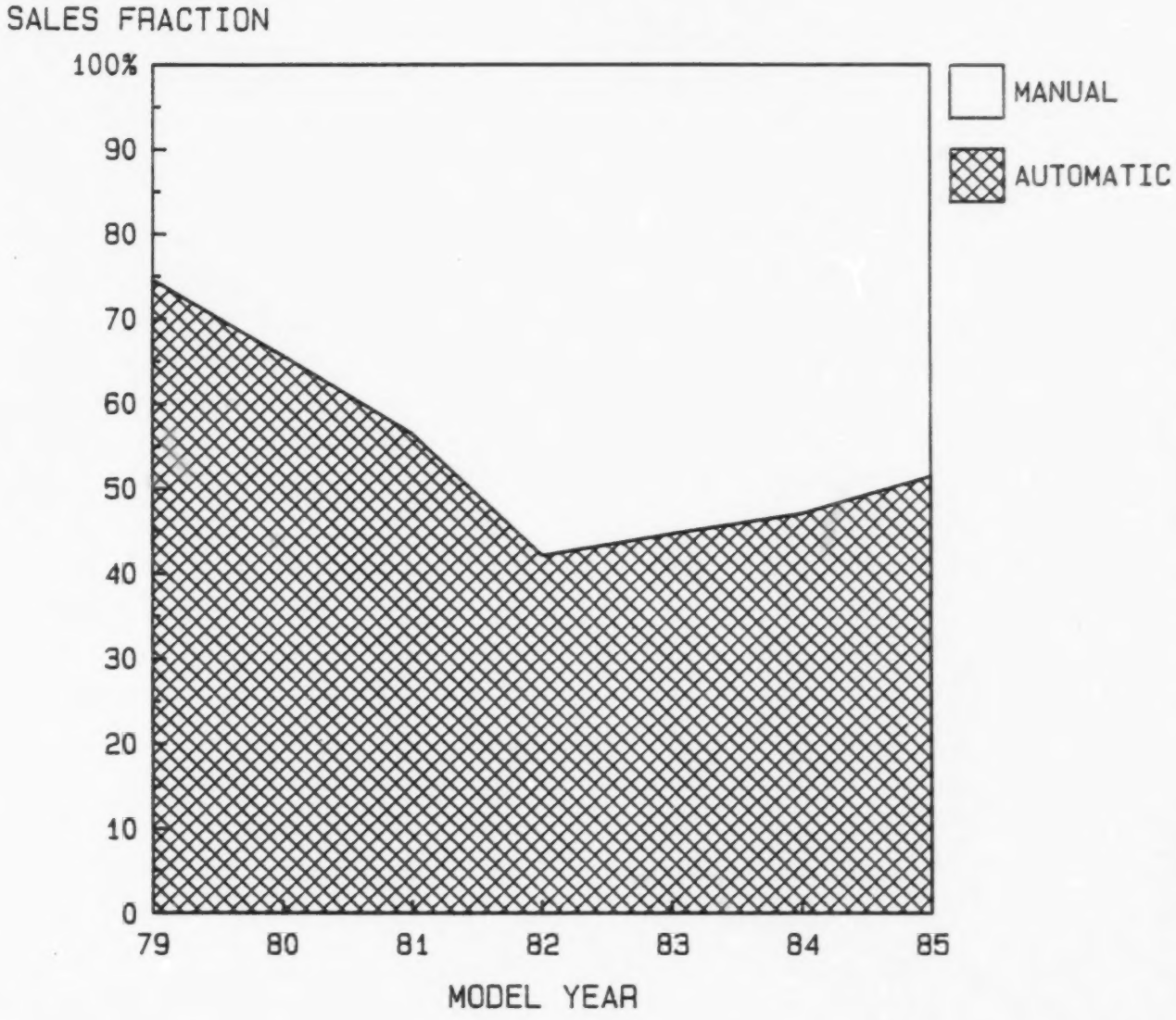
SOURCE: EMR/TED

FIGURE 23
CANADIAN NEW LDT FLEET
(Weight by Subfleet)



NOTE: WEIGHTS ARE EXPRESSED AS INERTIA WEIGHT CLASS
SOURCE: EMR/TED

FIGURE 24
CANADIAN NEW LDT FLEET
(Auto vs Manual Transmission)



SOURCE: EMR/TKD

accounted for 21.3%. In 1979, no vehicles were equipped with this latter technology. The more fuel-efficient transmissions were introduced beginning in 1980 mainly on heavier vehicles that would benefit the most from these advanced transmission techniques.

Consumer choice of manual transmissions has been even more striking. In 1979, 25.5% of light-duty trucks used manual transmissions, of which one quarter were equipped with overdrive. By 1985, manual transmissions represented 49% of transmissions sold, and about 84% of them were equipped with an overdrive gear ratio. The average weight of vehicles fitted with manual transmissions has decreased slightly in the last five years as well. For comparison, from 1979 to 1985 the market share of manual transmissions increased from 21% to over 30% in passenger cars, while it increased from 25% to 49% in light-duty trucks.

The use of front wheel drive in LDTs has not been extensive (Figure 25). For 1984, only 2% of pick-ups were designed with front wheel drive. Until 1984, both vans and SPV's showed no use of front-wheel drive. In 1984, 51% of vans had front-wheel drive, largely because of the introduction of Chrysler's mini-van. General Motors' and Ford's new vans will continue to be rear-wheel drive.

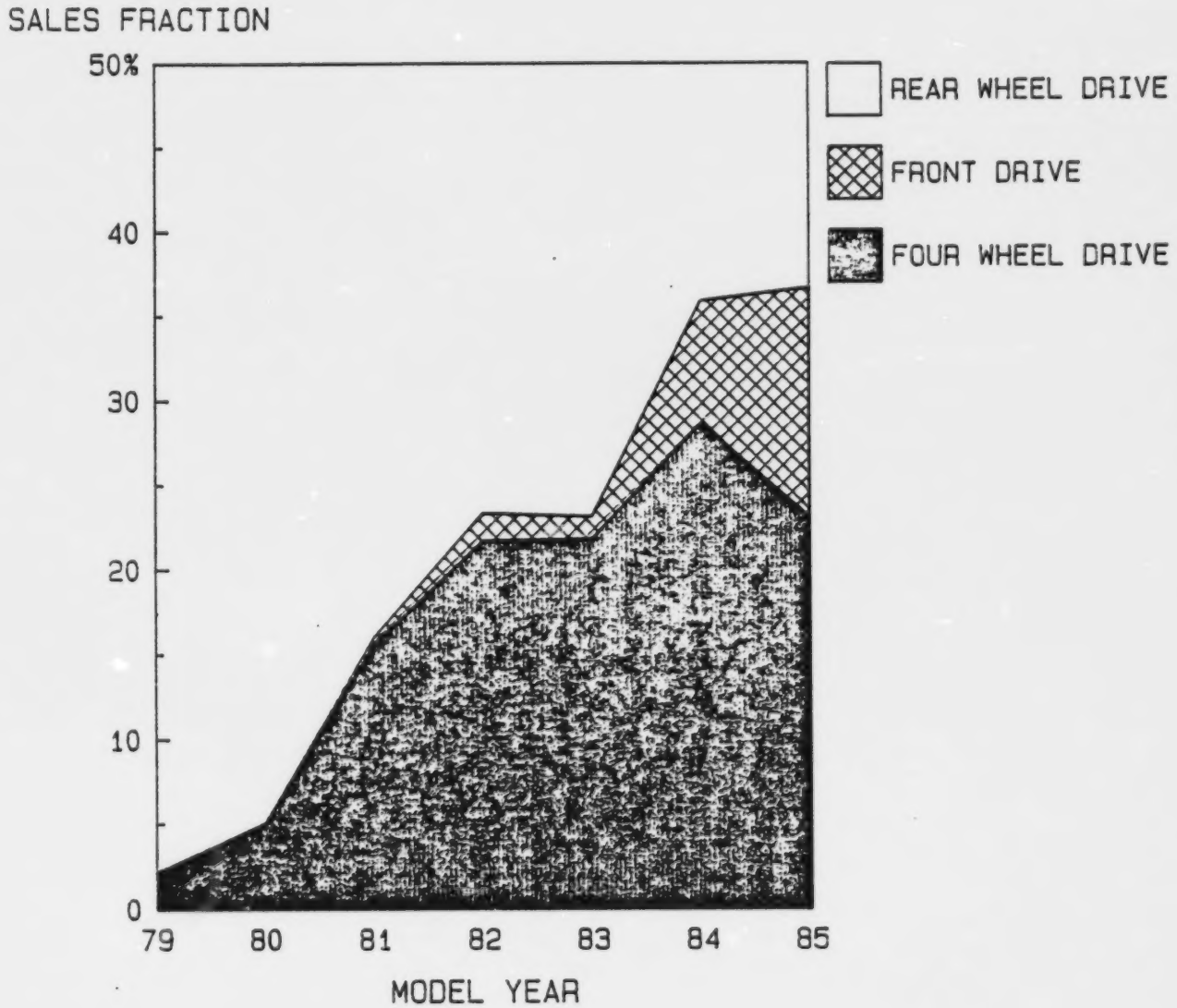
2.2.2.3 Fuel Systems

The carburetor has continued to be the mainstay of the light-duty truck fleet (Figure 26). For model year 1979, 95%, 97% and 100% of pick-ups, vans and SPVs respectively were fitted with carburetors. In 1985 these figures are 85%, 85%, and 81%. Figure 27 presents fuel injection usage for the Pick-ups, Vans and SPV subfleets.

2.2.2.4 Engine Displacement

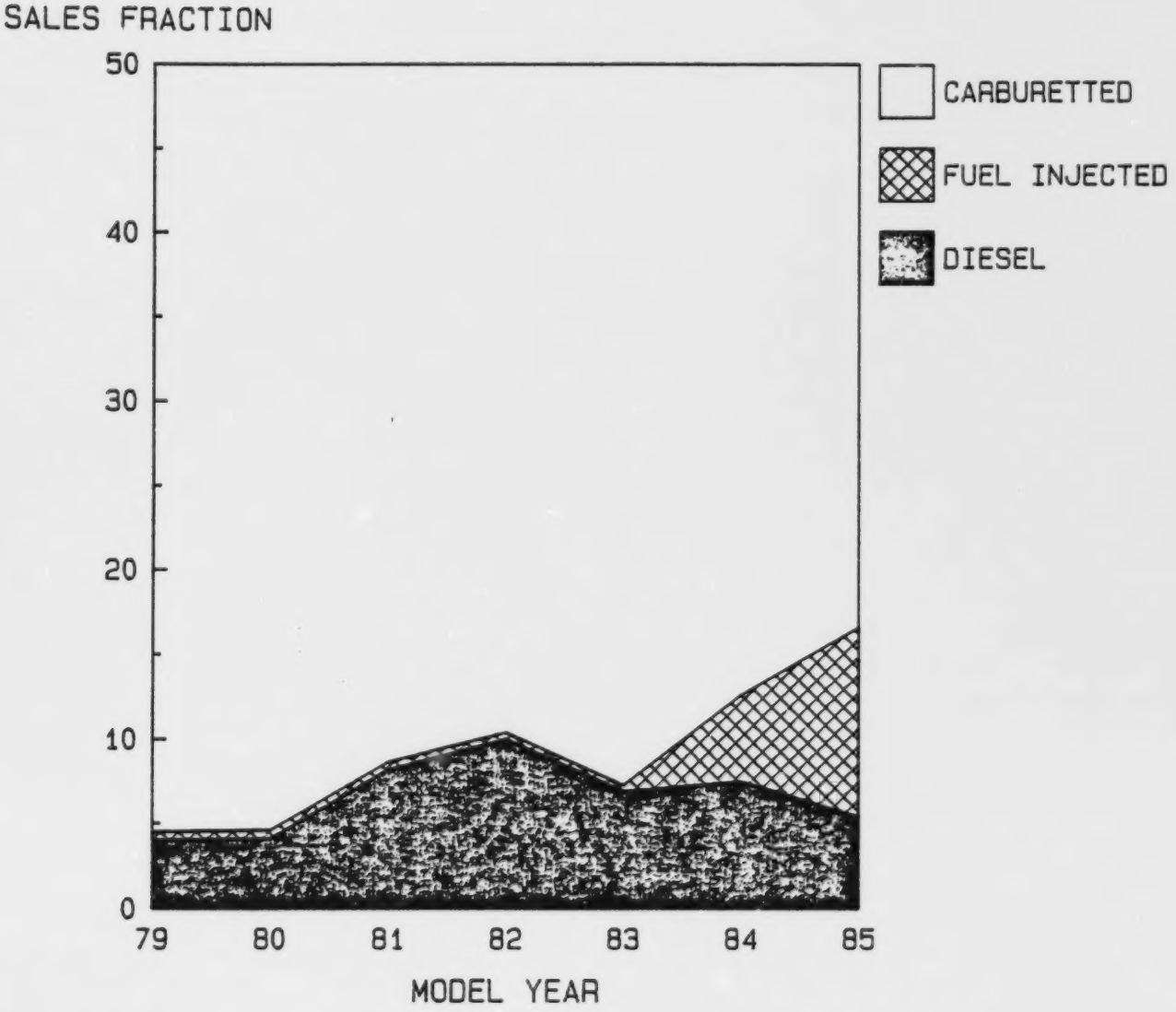
The average displacement of engines in the light-duty truck segment has decreased considerably (Figure 28). In 1979 the average displacement

FIGURE 25
CANADIAN NEW LDT FLEET
(Front vs. Rear Wheel Drive)



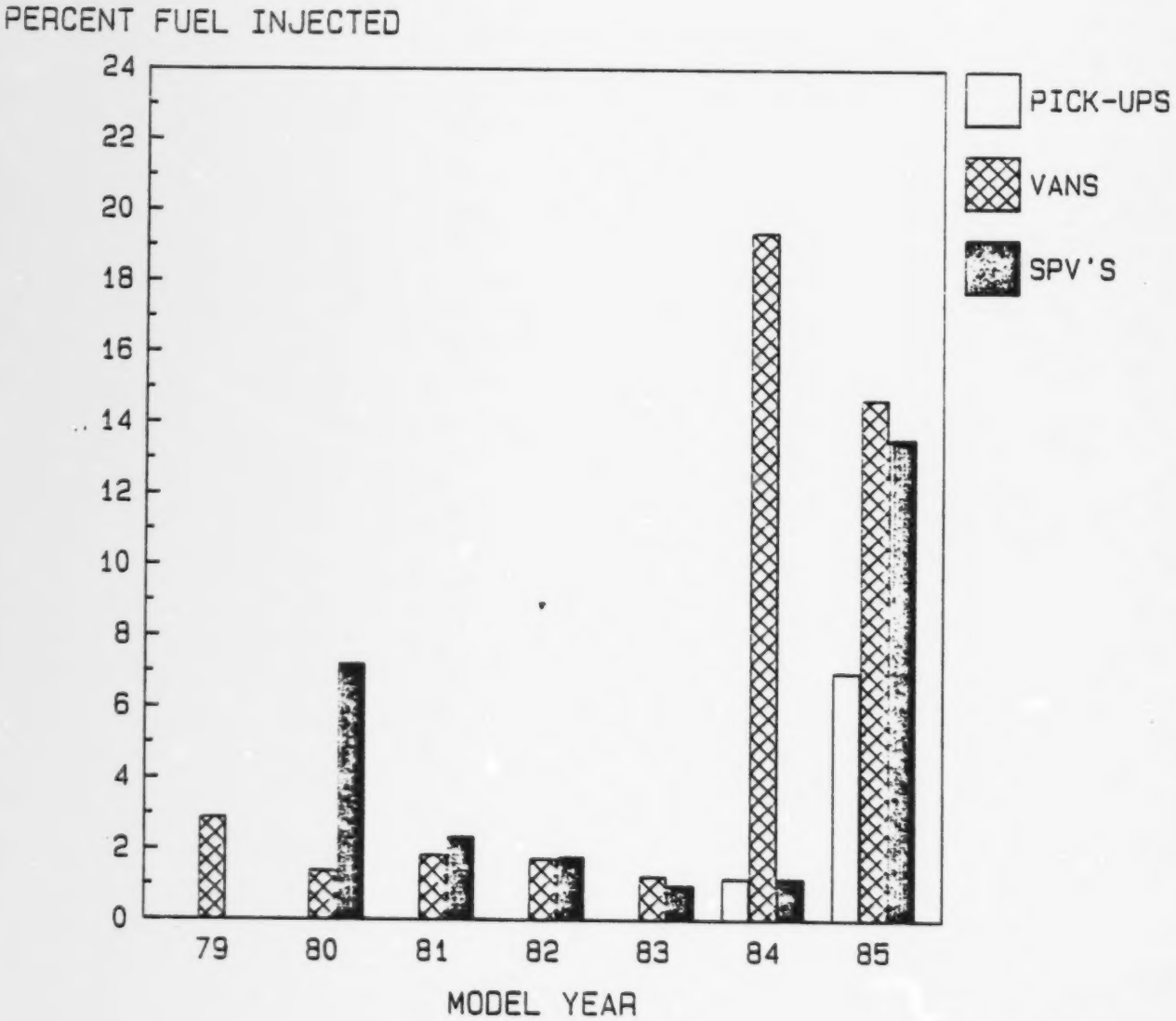
SOURCE: EMR/TED

FIGURE 26
CANADIAN NEW LDT FLEET
(Carb., Fuel Injected and Diesel)



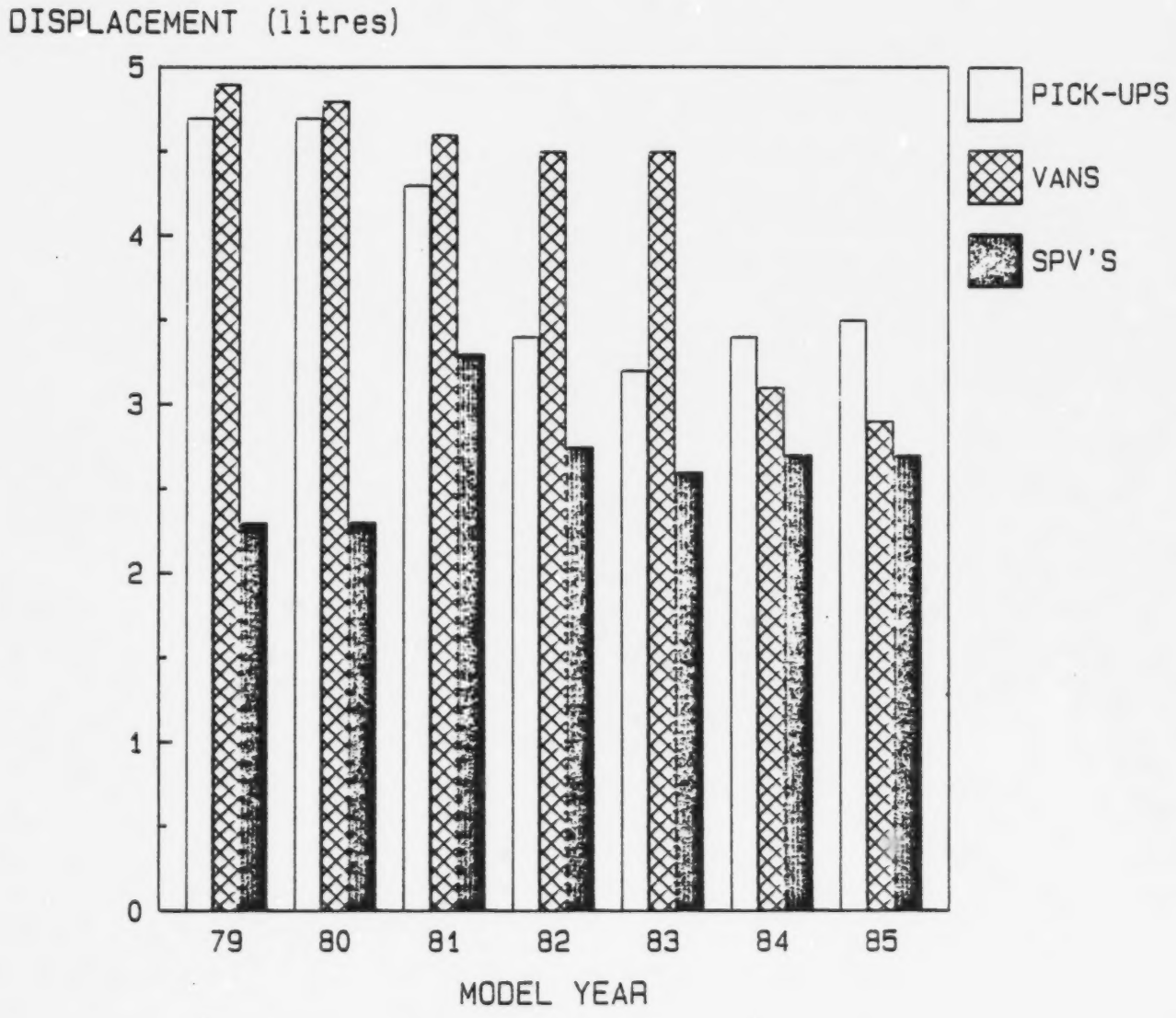
SOURCE: EMR/TED

FIGURE 27
CANADIAN NEW LDT FLEET
(Fuel Injection Usage by Subfleet)



SOURCE: EMR/TED

FIGURE 28
CANADIAN NEW LDT FLEET
(Engine Displacement by Subfleet)



SOURCE: EMR/TED

was 4.7 L, compared with 3.2 L in 1985, a reduction of 32%. The largest changes have taken place in the pick-up and van segments. For vans the average displacement dropped from a high of 4.9 L in 1979 to the current 1985 figure of 3.0 L. The pick-up displacement reduction is slightly smaller from 4.7 L to 3.5 L in the same time period. SPV displacement has increased from 2.3 L in 1979 to 2.7 L in 1985.

The reduction in average engine displacement is evidenced by a major shift away from eight-cylinder engines. For model year 1985, eight-cylinder engines comprised only 13% of the light-duty truck sales, compared with the 1979 figure of 65%.

The largest shift has been to four-cylinder engines, which had 11% penetration in 1979 but 47% penetration in 1985. Six-cylinder engines grew from 24% in 1979 to 40% of the market in 1985.

For 1985, approximately 64% of four-cylinder light-duty trucks use manual transmissions, while approximately 10% of eight-cylinder trucks employ them.

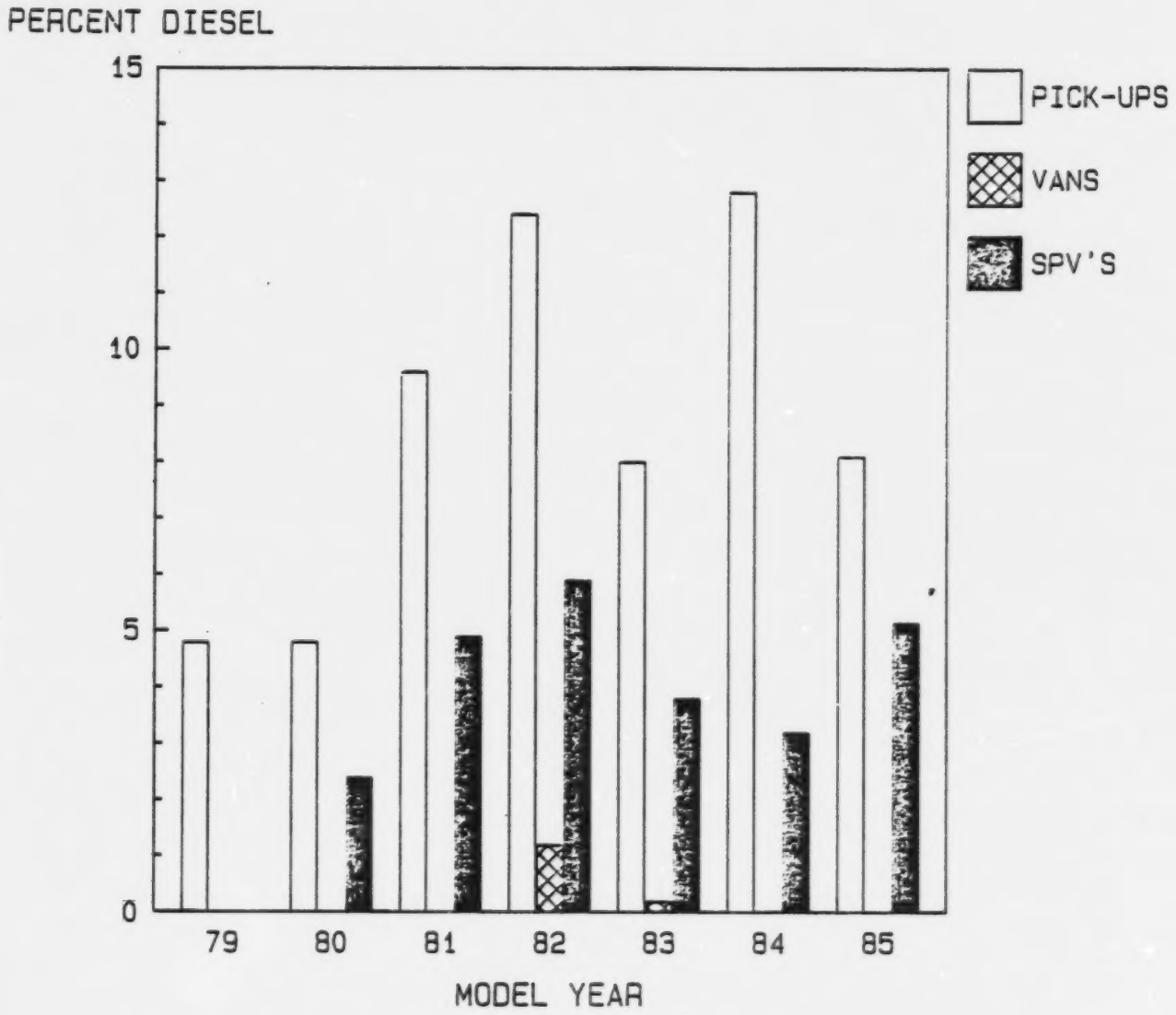
The type of fuel required by LDTs has remained relatively constant over time. In 1979, 84% of light-duty trucks required unleaded fuel while in 1985, 85% demanded unleaded fuel.

2.2.2.5 Diesels

The overall penetration of diesels in light-duty trucks (Figure 26) increased from 3.5% in 1979 to a peak penetration of 9.9% in 1982, followed by a decrease to 5.4% in 1985. The low use of diesels is explained in part by the fact that diesel utilization is virtually nil in vans (Figure 29).

When pick-ups alone are considered, diesel sales now account for 8.1% of sales in 1985 while in 1979 diesels were fitted to only 4.8% of this class. The SPV diesel penetration grew from nil in 1979 to 5.2% in 1985.

FIGURE 29
CANADIAN NEW LDT FLEET
(Diesel Engine Usage by Subfleet)



SOURCE: EMR/TED

As with passenger cars, the penetration of LDT diesels that one would have expected on the basis of fuel consumption alone has not taken place. For instance, in 1984, the diesel share was greatest in the 3000-lb LDT weight class. In this class, the average combined fuel consumption was 6.4 L/100 km for diesel vehicles, but 9.4 L/100 km for gasoline vehicles (with equivalent engine displacement). This large fuel consumption advantage has been offset by consumer consideration of items such as higher initial purchase cost, fuel availability problems, engine noise and poor winter startability.

2.2.3 Light-Duty Vehicle (LDV) Use (Passenger Cars and Light Duty Trucks)

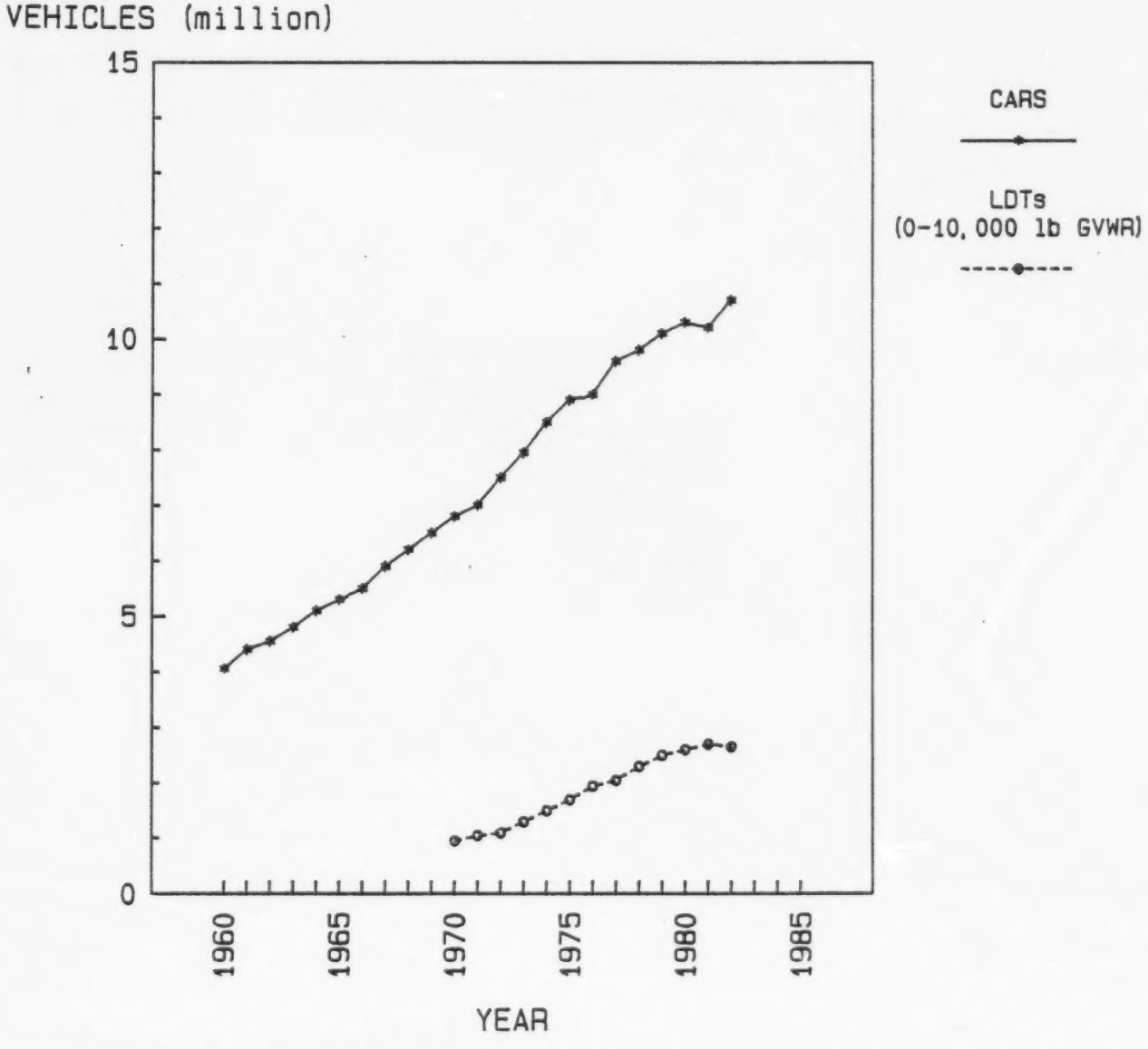
The fuel consumed by all light-duty vehicles currently in service, depends primarily on the number of vehicles on the road, kilometres driven by them and individual vehicle fuel efficiency. The discussions in previous sections have attempted to detail the dramatic new vehicle fuel efficiency improvements made during the 1978-1985 period that are at work reducing gasoline demand in Canada.

The on-road vehicle stock, shown in Figure 30, has increased by 6% since 1978 and now totals 13.4 million vehicles. Vehicle use however, is somewhat more difficult to assess. Surveys conducted by Statistics Canada indicate that vehicle use has decreased in the 1978-1983 period as shown in Figure 31. By combining vehicle stock data with average distance travelled, the total vehicle miles travelled (V.M.T.) can be shown to have increased by about 2% in the 1978-1983 period. Fuel demand reductions, then, must be entirely attributed to improved new vehicle fuel efficiency and conservation practices.

3. FACTORS INFLUENCING CHANGE

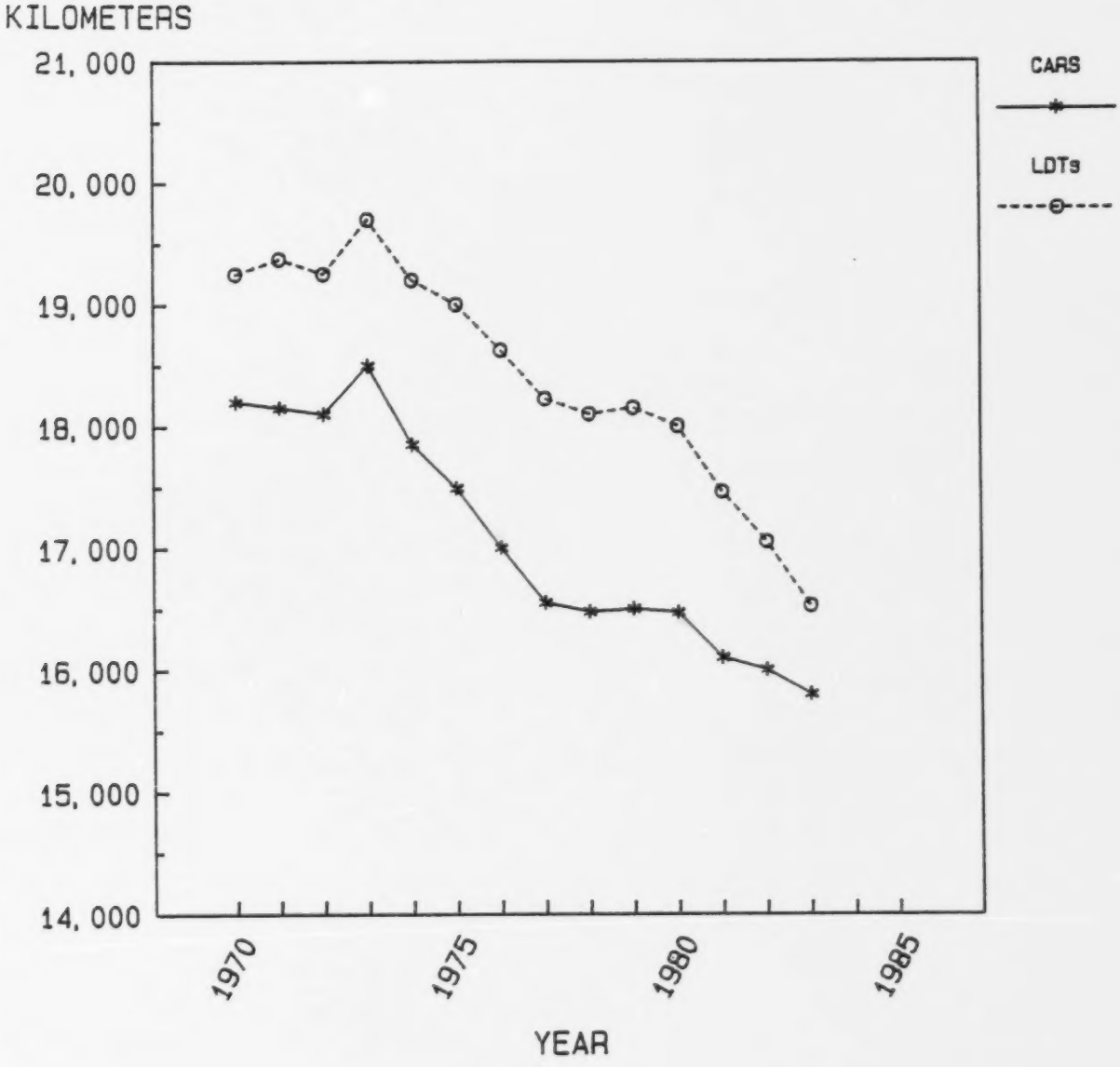
The dramatic improvements in new vehicle fuel consumption and subsequent drop in gasoline demand in the 1978-1984 period have been influenced by many factors. It is difficult, probably impossible, to determine the precise influence of each factor; however, the following discussion outlines the main factors that have been at work.

FIGURE 30
TOTAL CANADIAN VEHICLE STOCK
CARS AND LDTS (0-10,000 lb GVWR)



NOTE: ON-ROAD STOCK NUMBERS INCLUDE ALL CARS AND TRUCKS UNDER 10,000 lb GVWR
SOURCE: EMR/TED

FIGURE 31
AVERAGE YEARLY DISTANCE TRAVELLED



NOTE: LIGHT-DUTY TRUCKS UP TO 10,000 lb GVWR
SOURCE: EMR/TED

3.1 Fuel Price

Although international oil prices increased tenfold in the 1973-1981 period, the change in gasoline price charged to the consumer did not undergo such a dramatic increase. Nonetheless Table 1 shows that average retail prices for leaded regular gasoline increased 2.3 times from $0.20/litre in 1978 to $0.46/litre in 1983. When the effects of inflation are included the table shows that the 1984 price in real terms was 1.45 times the price charged in 1978.

The concept of price elasticity of demand is often used to measure consumers' sensitivity to changes in price. The concept implicitly takes into account a large number of variables including the need for the product, availability of a substitute product and the relative importance of the product in the consumer's budget.

The many studies of the relationship between gasoline price and resultant gasoline consumption have estimated the long-term elasticity at between -0.4 and -1.0. Thus a 1% increase in gasoline price could lead to a decrease in demand in the long term of between 0.4% and 1.0%.

One indication of the possible correlation between fuel price and new car fuel consumption is illustrated in Figure 32. Comparing this graph of fuel prices in Canada and the U.S.A. with Figure 8 shows that when Canadian fuel prices were higher than those in the U.S., average new car fuel consumption in Canada was lower. The converse is also true. Although no cause-and-effect relationship is claimed, the visual correlation offers some evidence of the effect of fuel price on reducing fuel demand. It is also felt that "fuel price expectations" are an important element in a consumers buying decision process. Figure 32 also shows how U.S. fuel prices (in terms of the pump price) has remained constant for some years leading to a sense of security on the consumer's part. Thus, the consumer may purchase a less fuel efficient vehicle because he finds the vehicle's annual fuel bill acceptable now and in the future.

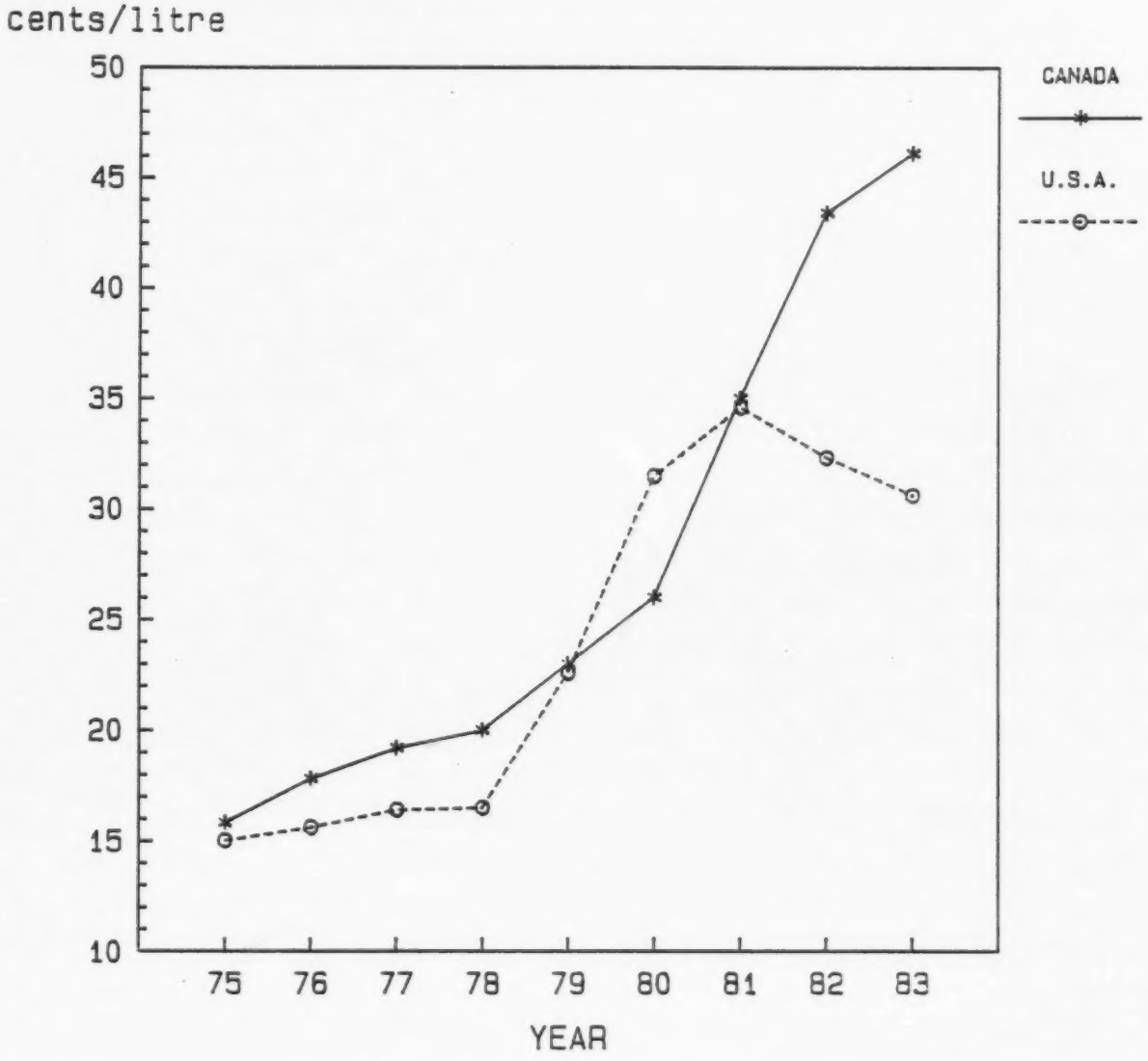
TABLE 1

Nominal and Real Prices of Regular Leaded Gasoline, 1973-1983

YEAR	NOMINAL REGULAR LEADED GASOLINE PRICE*	C.P.I. 1971=100	"REAL" REGULAR LEADED GASOLINE PRICE (1978 BASIS)
1973	12.00	112.70	18.7
1974	13.90	125.00	19.5
1975	15.90	138.50	20.1
1976	17.70	148.90	20.8
1977	19.20	160.80	20.9
1978	20.00	175.20	20.0
1979	21.90	191.20	20.1
1980	25.90	210.60	21.5
1981	35.30	236.90	26.1
1982	42.90	262.50	28.6
1983	45.90	277.60	29.0

* Price expressed as cents (CND)/litre

FIGURE 32
AVERAGE RETAIL PRICE
LEADED REGULAR GASOLINE



SOURCE: U.S Oakridge National Lab.Data Book
E.M.R. Data Book

The dynamics of gasoline demand are however, complex, and it is very difficult to attribute recent demand reductions to price increases alone. Moreover, the consumer and manufacturer response to price shocks in the 1970's is not yet complete (in that technologies introduced as a result of those shocks have not yet reached full penetration of the on-road fleet). Fuel price increases have undoubtedly reduced demand but the magnitude of this influence is uncertain.

3.2 Foreign Competition

After World War II the European and Asian (mainly Japanese) automobile industries developed in a very different environment from that which existed in North America. The combination of high fuel taxes, crowded cities, narrow roads and low per capita income found in Europe and Asia, led their manufacturers to focus on small, low-priced, fuel-efficient vehicles. When the oil (shortages) and price increases suddenly occurred in the 1970's, foreign manufacturers were in a good position to increase their share of the large North American market. They had the product that the consumer wanted. In Canada, imports rose from 20% of total sales in 1978 to a peak of 35% in 1982. Voluntary export restraints were judged desirable at this time for both Canada and the U.S., protecting the domestic industry.

By 1984 the North American industry had responded to the competition. Product design and quality control had improved, fuel efficiency was equal to foreign competition and production cost was more competitive although still somewhat higher than for similar imports. Adjustments further reducing production costs are in progress. The competition is not expected to subside with foreign manufacturers continuing to improve their products. The domestic industry is adapting to this international competition through actions such as joint ventures, and global sourcing of components. The result may be a blurring of the traditional distinctions between North American, European and Asian automobiles.

3.3 Buying Patterns

In the interval 1978 to 1984, consumers' buying preferences have changed towards smaller, more fuel efficient cars. Figure 13 shows the change. Classes 2 and 3, which are minicompacts and subcompacts, maintained their market share at 27% in 1978 and 29% in 1984. Class 4, (compact cars), increased its share from 18% in 1978 to 30% in 1984, while full-sized cars in class 6 declined from 15% of sales in 1978 to 7% of sales in 1984.

3.4 Government Programs

Government initiatives in both Canada and the U.S.A. since the 1973 oil crisis have attempted to ensure that fuel efficiency improvements are realized in light-duty vehicles. Since the Canadian automobile industry is heavily influenced by activities in the United States, the U.S. government programs are discussed and are presented first.

3.4.1 United States Programs

3.4.1.1 CAFE Program - Passenger Cars

The main U.S. program aimed at improving fuel economy in the new passenger car fleet is the Corporate Average Fuel Economy (CAFE) program introduced in 1976. This program has required all companies marketing passenger cars in the U.S. to meet progressively tighter yearly corporate average fuel economy standards for new passenger cars sold, beginning with the 1978 model year. The program also requires testing to be carried out using standardized procedures and provides for significant fines for companies failing to meet the annual standard. Under the program, manufacturers are allowed to carry forward and carry back credits; i.e. corporate average levels which are better than the standard in past years (or expected to be better in future years) can be used to off-set a failure to meet the standard in a given year. The CAFE levels specified for the 1978 to 1985 period are shown in Table 2. Over eight model years the standards required a 53% improvement in new passenger car fuel economy.

TABLE 2

United States CAFE Standards and Canadian Fuel Consumption Objectives, 1978-1986

Model Year	Passenger Cars		Light-Duty Trucks (U.S.)**		
	U.S. CAFE Standard, mi./U.S. gal.	Canadian objective,* L/100 km	Two-wheel drive mi./U.S. gal.	Four-wheel drive mi./U.S. gal.	Combined*** mi./U.S. gal
1978	18.0	13.1	-	-	-
1979	19.0	12.4	17.2	15.8	-
1980	20.0	11.8	16.0	14.0	-
1981	22.0	10.7	16.1	15.0	-
1982	24.0	9.8	18.0	16.0	17.5
1983	26.0	9.0	19.5	17.5	19.0
1984	27.0	8.7	20.3	18.5	20.0
1985	27.5	8.6	19.7	18.9	19.5
1986	27.5****	8.6****	20.5	19.5	20.0

* The Canadian objective is identical to the U.S. standard, but expressed in metric units of L/100 km.

** There are no Canadian objectives for light-duty trucks.

*** Since 1982 manufacturers have had the option of using a combined standard for two and four-wheel drive vehicles.

**** In the United States, the 1985 standard automatically carries over into future years unless the government announces a change. In Canada, the objective can be extended beyond the 1986 model year by Ministerial announcement.

The CAFE program also includes publication of an annual fuel consumption guide by the Department of Energy (DOE) and labelling of new vehicles with representative fuel economies by the manufacturer.

3.4.1.2 CAFE Program - Light-Duty Trucks (LDT's)

In March 1977, the United States set the light-duty truck standards for model year 1979. These standards covered only the light-duty trucks with gross vehicle weight rating (GVWR) of 6000 lb or less. A year later, standards were set for model years 1980 and 1981. Two and four wheel drive classes were also established. Also, the GVWR limit was raised to 8500 lbs, which tripled the number of vehicles covered by the regulations. The 1981 standard for the two-wheel drive light trucks was lowered in 1979 in response to a request and new information from Chrysler Corporation. The standards for model year 1982 were set in March 1980 and the 1983-1985 standards were set in the fall of 1980. This last rulemaking provided a composite standard, covering all of a manufacturer's light trucks, which it may elect to meet instead of the separate standards for the two-wheel drive and four-wheel drive classes.

The United States Government has just recently reviewed the 1985 standards and set 1986 LDT standards. In response to petitions and information supplied by Ford, it was decided that the standards set in 1980 for model year 1985 were not obtainable given the state of the American light truck market and the price of fuel. As a result, the 1985 standard was decreased and the 1986 standard set lower than the orignial 1985 standard. Table 2 also summarizes the standard setting activity in this area.

3.4.1.3 Gas Guzzler Tax

The U.S. "Gas Guzzler Tax" was approved as part of the National Energy Act signed by President Carter in 1978. The purpose of the tax was to discourage production of vehicles with poor fuel economy by imposing a tax on these vehicles regardless of the manufacturer's state

of compliance under CAFE. The tax increased annually for a given level of fuel economy. Table 3 shows that in 1980 a vehicle obtaining between 13 and 14 miles per U.S. gallon was subject to a tax of $300. The same vehicle in 1986 would be subject to a tax of $3200. This tax has not been effective in discouraging the purchase of luxury and performance cars but is perceived to have influenced manufacturers to dramatically improve the fuel efficiency of certain large domestic vehicles thereby avoiding the tax. In some cases models were discontinued.

3.4.2 Canadian Programs

3.4.2.1 Motor Vehicle Fuel Consumption Program

The Canadian program is similar to the U.S. CAFE program, except that it is administered on a voluntary rather than mandatory basis. Details are given in Appendix II. The program was targetted to reduce new vehicle fuel consumption by about 35% in the 1978-1985 period. Within this general objective was a desire to ensure that Canada realized the full benefits of the fuel economy improvements that were expected to be achieved in the United States.

To date all major manufacturers have met the Company Average Fuel Consumption (CAFC) objective, except for Ford and General Motors who have used carry-forward credit provisions to satisfy program objectives in 1983 and 1984 model years. Companies needing to use credits (including 10 minor manufacturers) represent 53% of sales in the Canadian new car market.

Overall new vehicle fleet fuel consumption levels in Canada have been equal to or better than levels achieved in the United States for all years except 1980. From 1982 through 1984, the Canadian fleet has averaged 6% better fuel consumption than the U.S. fleet (Figure 8).

TABLE 3

United States Gas Guzzler Tax on New Cars*
($)

Vehicle Fuel Economy	Corporate Average Fuel Economy Standards (CAFE)						
	1980 20.0	1981 22.0	1982 24.0	1983 26.0	1984 27.0	1985 27.5	1986 27.5
22.5 mpg			0		0		0
21.5-22.5			0		0		500
21.0 mpg	0	0		0		0	
20.5-21.5			0		0		650
20.0-21.0	0	0		0		500	
19.5-20.5			0		0		850
19.0-20.0	0	0		0		600	
18.5-19.5			0		450		1050
18.0-19.0	0	0		350		800	
17.5-18.5			200		600		1300
17.0-18.0	0	0		500		1000	
16.5-17.5			350		750		1500
16.0-17.0	0	200		650		1200	
15.5-16.5			450		950		1850
15.0-16.0	0	350		800		1500	
14.5-15.5			600		1150		2250
14.0-15.0	200	450		1000		1800	
13.5-14.5			750		1450		2700
13.0-14.0	300	550		1250		2200	
12.4-13.5			950		1750		3200
13.0	550	650		1550		2650	
12.5			1200		2150		3850

Source: Department of Energy, Office of Public Affairs, "Department of Energy Information", Washington, D.C., October 20, 1978.

* The table presents data on the "Gas Guzzler Tax" for fuel inefficient new cars. This tax was considered a key provision of the National Energy Act, passed by the U.S. Congress and signed by the President in 1978. For example, any year model 1985 automobile that does not achieve a fuel economy of 21 mpg will be penalized. The amount of tax levied against the vehicle would range from $500 to $2650, depending on the fuel economy rating of the vehicle. Particularly, the gas guzzler tax becomes relevant as some domestic manufacturers announce their inability to meet corporate average fuel economy standards. The likelihood that a larger portion of automobiles produced will carry this "Gas Guzzler Tax" becomes significant.

A second purpose of the program was to assist and encourage new vehicle purchasers to select fuel efficient vehicles by making available to them reputable information regarding the relative fuel consumption of most vehicles available for sale. Information has been provided to consumers in the form of the annual Fuel Consumption Guide published by Transport Canada, the Car Economy Book published by Energy, Mines and Resources Canada, and the voluntary affixing of labels to vehicles by manufacturers.
More detail on these activities is given in Appendix II.

3.4.2.2 Public Information and Education

Consumer behaviour which is the most amenable to conservation efforts is the purchase of a fuel efficient vehicle and the fuel efficient operation of that vehicle. Consequently, most public information and education (PI&E) programs conducted in Canada and elsewhere have focussed on these target behaviours. The federal government's PI&E program has focussed specifically on new vehicle purchases by; providing the consumer with the annual Fuel Consumption Guide and the Car Economy Book; by requesting that manufacturers affix a fuel consumption label on each vehicle produced, and by establishing guidelines requiring the fair use of fuel consumption ratings in advertisements.

Based on consumer surveys it is estimated that at least 15% of new vehicle purchasers have seen the Fuel Consumption Guide (FCG) prior to their purchase. Given that 50% of those who have seen the Guide have used it and that 60% of those who have used it say it has influenced them to purchase a more fuel efficient vehicle, it is estimated that the FCG has influenced about 5% of new car buyers to conserve fuel by purchasing a more fuel efficient vehicle. No information is available on the extent of the improvement in fuel efficiency obtained by these people. However, as an indication of the possible scale of the savings, it can be calculated that the total savings would be of the order of $20 million if the vehicles chosen by the affected buyer were an average 1 L/100 km more fuel-efficient than the vehicle they may have otherwise chosen.

While manufacturers have voluntarily agreed to ensure that the vehicles that they produce are affixed with fuel consumption labels, it appears that many dealers remove the labels when the new vehicle is placed in the showroom or on the sales lot. According to the most recent survey of dealers, only about half of the vehicles on lots and considerably fewer in the showrooms, retain their labels. Based on consumer surveys, it is estimated that about 2-3% of new vehicle buyers in Canada are influenced by the labels each year. If this influence has resulted in the purchase of a vehicle which consumed 1 L/100 km less than would otherwise have been purchased, the labelling program may have resulted in a saving of about 10 million dollars per year in unconsumed fuel. The cost to the government of the labelling program is negligible. The cost to industry is not known but it is highly unlikely to approach 10 million dollars.

While the impact of the advertising guidelines is impossible to quantify monetarily, they have minimized the use of misleading advertising by manufacturers and have contributed to the public's awareness that the federal governement is concerned about fuel conservation. The latter has been achieved through the stipulation that manufacturers indicate in their advertisements that the fuel consumption ratings have been derived "using Transport Canada approved test methods".

3.4.2.3 Automobile Weight Tax

The Federal Government automobile weight tax has been in force since 1975 to discourage the purchase of heavier cars. Table 4(a) summarizes the tax structure. Table 4(b) shows the revenues collected under this tax between 1976 and 1984. The tax initially applied to less than 10% of passenger cars sold and now applies to less than 2%; as a result, this tax's impact on new vehicle fuel economy has been decreasing, and is probably very small.

TABLE 4

CANADIAN AUTOMOBILE WEIGHT TAX

(a) Tax Structure

Tax: = $30 on first 45 kg over limit
= 40 on second 45 kg over limit
= 50 on third 45 kg over limit
= 60 on each additional 45 kg over 135 kg

Base Weight = 2007 kilograms for standard automobiles
= 2268 kilograms for stationwagons

(b) Revenues Collected, 1975-1984

Financial Year Ending March 31	Dollars Collected in Thousands
1975	2195
1976	9441
1977	12263
1978	19787
1979	5865
1980	2076
1981	789
1982	1255
1983	990
1984	673

Source: Department of Finance

R174/3250R

3.4.2.4 Air Conditioner Excise Tax

In individual vehicle tests, air conditioning has been shown to increase fuel consumption by between two and twenty per cent, depending on the vehicle and use patterns. In the United States, total year-round fuel consumption for all light-duty vehicles is probably about two per cent higher as a result of the use of air conditioning, (according to estimates by the United States Environmental Protection Agency); this number would be lower for Canada.

Since 1977, a federal excise tax has been in place in Canada to discourage the purchase of vehicles equipped with air conditioning. The flat tax of $100 per vehicle has been collected for an increasing volume (and percentage) of vehicle sales as shown in Table 5. The air conditioning option is an $800-$1000 extra cost per vehicle before application of the excise tax.

4. FUTURE CONSERVATION OPPORTUNITIES

4.1 New Technology

The fuel efficiency of new automobiles has improved dramatically during the past years. Is there still opportunity for further improvement? Extensive automotive research has led to the identification of several methods of further improving fuel consumption. The technologies may be grouped into three areas:

Vehicle programs including weight reduction, material substitution, transverse front-wheel drive, accessory load reductions, aerodynamic drag and rolling resistance reduction.

TABLE 5

AIR CONDITIONING EXCISE TAX

Fiscal Year	Air Conditioning Sales			Revenues Collected ($ million)
	Total Vehicle Sales (thousands)	AC Sales (thousands)	AC %	
1977	1 252	124	9.9	12.4
1978	1 278	121	9.5	12.1
1979	1 167	237	20.3	23.7
1980	1 255	292	23.3	29.2
1981	1 025	247	24.1	24.7
1982	951	257	27.0	25.7
1983	1 010	197	19.5	19.7

Source: Department of Finance

Drivetrain improvements including expanded development and use of four-speed automatic transmission with torque converter lock-up and development and introduction of the computer-controlled continuously variable transmission (CVT).

Engine improvements including microprocessor-controlled engine functions such as air/fuel ratio, ignition timing; higher compression ratios; reduced internal friction. Smaller displacement engines with turbo/supercharge power boosting permit a power management concept exhibiting a two-tier power availability from a low displacement engine.

Simultaneous implementation of technologies in the three categories could, if all technologies were available for introduction, achieve a further 30% improvement in automotive fuel consumption. The costs and likely implementation patterns of these technologies are currently under study.

In addition to technology that generally improves efficiency, the development and introduction of vehicles that operate on alternative fuels can reduce dependence on oil-based fuels and offer other benefits such as reduced exhaust emissions. The technology for propane and natural gas adoption is presently available. Close to 100,000 vehicles in Canada operate on propane, and the number operating on natural gas is expected to grow quickly. Engine and fuel system changes will also permit the use of alcohol-gasoline blends without difficulty to the consumer in the near future.

Most of the vehicles now using alternative fuels were converted from gasoline systems. Many are dual-fuelled. There are, however, some factory-produced models on the road. In the future, production of alternative-fuelled vehicles by vehicle manufacturers can greatly expand the use of non-oil fuels. In addition to propane and natural gas, prospects are excellent that methanol vehicles can be produced in large numbers in the 1990's.

4.2 Other Factors

Projection of improvements in fuel efficiency, and of changes in fuel demand depend on what value one assumes for a number of interacting variables, such as oil prices, government standards/regulations, foreign competition, technological advances, consumer buying trends, personal travel patterns, automobile sales and general economic conditions.

These variables, and their eventual impact on fuel demand, are under study by Energy, Mines and Resources Canada, in cooperation with Transport Canada. Such projections are difficult, and fraught with uncertainty. There are, however, a few things that can be said with some confidence:

a. Over the next few years, fuel-efficient technologies that have already been installed or planned for installation will continue to reduce fuel demand by replacing older less efficient vehicles, assuming no major shifts occur in the size and fuel efficiency of vehicles sought by new car and light-truck buyers.

b. Competition from imported vehicles will continue to provide an incentive for the North American industry to improve its offerings. It should be recognized, however, that within individual vehicle classes, foreign manufacturers no longer hold the large advantage over domestic manufacturers that they once held in fuel efficiency.

A few years ago fuel efficiency was generally equated with "small cars". Technological improvements have now made it possible for motorists to get all the comfort and services they want out of a vehicle while keeping fuel costs reasonable. Currently, consumers are focussing on fuel efficient cars in the medium size ranges, principally compacts. These cars are often well equipped with options and special features, providing economy without sacrificing life style.

Current purchasing patterns, especially in the United States, indicate that many new car purchasers are buying larger cars than they might have 2-3 years ago. This trend, if it continues, could be a source of some concern among those who would wish to see average fuel efficiency continue to improve. On the other hand, given available technology, combined with "normal" economic conditions, the average fuel efficiency of new cars need not regress. In fact, technology is now available, or will soon be available, that can provide continued progress. To what extent this progress will happen depends on a great many factors, including the level of industry, government and consumer commitment.

APPENDIX I

LIST OF DATA SOURCES

EXPLANATION OF TERMS USED

EPA - The U.S. Environmental Protection Agency provided the data on American new passenger cars.

EMR/TED - New passenger car and light-duty truck data are submitted by manufcturers to the federal government of Canada in the format used to produce the Annual Fuel Consumption Guide booklet. The Transportation Energy Division of Energy, Mines and Resources (EMR/TED) appended additional information to each record such as inertia weight class. drive-type, supercharging, transmission features and vehicle size class codes. Most of the data and charts presented in this paper were generated directly from the EMR/TED data-base.

EMR/TED Data Book - The Transportation Energy Division has compiled the EMR/TED Data Book from many sources, chiefly Statistics Canada, to make available data on the energy demands of the Transportation Sector.

EMR/TED Fuel Demand Evaluation Model - Estimates generated by the fuel demand evaluation model are a function of historical fleet sizes, distances travelled, on-road fuel consumption by model year, and vehicle survival rates.

APPENDIX I

LIST OF DATA SOURCES (continued)

DATA SOURCES:

Figures 1A, 1B & 2	-	EMR/TED Data Book and Statistics Canada Catalogue #57-003
Figure 3,5,7,30&31	-	EMR/TED Fuel Demand Evaluation Model
Figures 4,6,8,-13 14A,15A,16A 17A & 18-29	-	EMR/TED Data-Base
Figures 14B,15B,16B 17B	-	EPA
Figure 32	-	U.S. Oakridge National Laboratory Data Book and EMR/TED Data-Book

APPENDIX II

CANADIAN MOTOR VEHICLE FUEL CONSUMPTION PROGRAM

1. Mandate

In December 1975, as part of a broad energy policy and conservation strategy initiated by the Minister of Energy, Mines and Resources, the Government authorized the Minister of Transport in cooperation with the Ministers of Energy Mines and Resources, Environment Canada and Industry Trade and Commerce to develop a schedule of sales-weighted fuel economy standards for motor vehicles sold in Canada. The Cabinet directed that the standards should not compromise environmental concerns as a result of vehicle emissions, result in a significant disruption of the Canadian automobile industry, nor should they be any less than the standards approved by the U.S. Government. The Minister of Transport was also authorized to publish annual fuel consumption ratings for new automobiles sold in Canada commencing with the the 1977 motor vehicle model year. The Government directed that contingency enforcement measures be prepared, requesting the Minister of Finance to consider the feasibility of fiscal measures, including an excise tax schedule on automobiles above a certain weight, to discourage importation of heavier, less fuel-efficient vehicles for sale in Canada and to encourage consumer preference for less expensive, fuel-efficient vehicles.

On February 25, 1976 the Minister of Energy, Mines and Resources announced the establishment of the Motor Vehicle Fuel Economy Program as part of a broad range of energy policy and conservation measures proposed by the government which included fuel consumption targets for the years 1980 and 1985. Annual targets were announced progressively for the intervening years. Extension of the 1985 target to 1986 was announced jointly in 1984 by the Ministers of Energy and Transport. The schedule of objectives, outlined below, is identical to the standards legislated by the U.S. Government:

Model Year	Litres/100 Kilometres	Miles Per Imperial Gallon
1980	11.8	24.0
1981	10.7	26.4
1982	9.8	28.8
1983	9.0	31.4
1984	8.7	32.5
1985	8.6	33.0
1986	8.6	33.0

As part of the Government's decision it was agreed that discussions would be held with the motor vehicle manufacturing industry and other parties concerning the fuel economy objectives. The industry advised the Government that they would comply on a voluntary basis with the targets announced for Canada for 1980 and 1985, and would also meet the 1978 and 1979 U.S. standards in Canada.

In January 1978 the Government reviewed submissions from the Ministers of Transport and Energy, Mines and Resources which outlined the strengths and weaknesses of the voluntary program to date and put forward options ranging from a continuation of the voluntary program, in varying forms, to a legislated program. The Government agreed to an expanded form of the voluntary program and reaffirmed its original decision of December, 1975 to achieve the maximum fuel economy standards for vehicles sold in Canada. The Departments of Transport, Energy Mines and Resources, and Justice were directed to prepare draft legislation regarding information requirements expected of motor vehicle manufacturers, labelling requirements and regulations regarding inter-provincial trade and the import of motor vehicles for sale in Canada.

The April 14, 1980 Speech from the Throne announced that Parliament would be asked to approve legislation setting mandatory fuel efficiency standards for automobiles sold in Canada.

The Energy Security Bill (C-94), which framed the Government's National Energy Program, was tabled in Parliament in June 1981. Part V of the Bill contained provisions related to the Motor Vehicle Fuel Consumption Standards Program. The Bill was subsequently divided into its component parts. In April 1982 the Motor Vehicle Fuel Consumption Standards Bill (C-107) was introduced to Parliament, receiving Royal Assent in July 1982.

The Act was drafted so that the legislation could be proclaimed in two parts. Part I of the Act sets out requirements of motor vehicle manufacturers to:

i) provide information to the Minister of Transport including the number of vehicles manufactured and/or imported for sale in Canada;

ii) label each motor vehicle for sale in Canada with the fuel consumption rating for its particular class;

iii) maintain company records in a specified manner;

iv) make provision for examination and inspection of records and vehicles.

The first part of the Act also gives the Minister of Transport authority to issue Fuel Consumption Marks and to conduct selective testing of motor vehicles by the Department to ensure compliance with the testing procedures and fuel consumption label values reported by the motor vehicle manufacturers. Part I also requires the Ministers of Transport and Energy to table an annual report to Parliament on the administration and enforcement of the Act.

The second part of the Act empowers the Ministers of Transport and Energy, Mines and Resources to establish fuel consumption standards. The Minister of Transport is to prescribe the conditions and procedures against which vehicles should be tested by the manufacturers, and the penalties and enforcement provisions of the regulations.

The Act was not proclaimed into law because of assurances from the Canadian motor vehicle manufacturers that they would voluntarily comply with the provisions of the legislation.

If found necessary the Government could proclaim the first part of the Act into law which would establish the information, reporting and investigation provisions of the Act. Concurrently or at a subsequent date the Government could proclaim the second part of the Act which would establish in law the standards, enforcement and penalty provisions of the legislation.

2. Objectives

Since its inception in 1975 the objectives of the Motor Vehicle Fuel Economy Program have been to conserve petroleum by encouraging the production of more fuel-efficient motor vehicles in Canada and, through Government and industry information programs, to assist and encourage consumers to select fuel-efficient vehicles.

3. Component Description

The Motor Vehicle Fuel Economy Program is an operating program of Transport Canada based on policies developed by EMR, whose main purpose is to reduce consumption of conventional fuels, such as gasoline and diesel. The main thrust of the Program is to encourage the introduction and purchase of more fuel-efficient motor vehicles which, when combined with retirement (scrappage) of older, less fuel-efficient vehicles, will result in a more fuel-efficient motor vehicle population in Canada.

The voluntary nature of the Program results in economies to both the government and the industry in monitoring and achieving the fuel consumption targets discussed above that may not have been realized through a mandatory program. Manufacturers have thus far been able to achieve the fuel consumption targets through vehicle redesigns.

The Program also maintains a flexibility of choice to the consumer in the selection and purchase of a wide range of motor vehicles based on price, style and performance.

The Minister of Energy Mines and Resources, through the Transportation Energy Division, provides policy rationale for the program, and in consultation with the Minister of Transport Canada establishes the fuel consumption targets and assesses the effects of the program toward achieving the overall energy goals of the Government.

Industry/government consultation on policy issues is carried out through the Government/Industry Motor Vehicle Energy Committee (GIMVEC). This committee, formed in 1983, is chaired by EMR and has representation from Transport Canada, the Department of Regional Industrial Expansion, the Motor Vehicle Manufacturers Association and the Automobile Importers of Canada.

Transport Canada, in consultation with Energy Mines and Resources and the industry, publishes on an annual basis "Guidelines for the Determination and Submission of Fuel Consumption Data". The Guidelines specify the types of vehicles to be tested, test procedures to be followed, how CAFC is to be calculated and the method by which motor vehicle manufacturers are to report information to the Government. The Guidelines also specify labelling and advertising procedures regarding fuel consumption to be followed by vehicle manufacturers.

The Guidelines are based, in part, on the Canadian Emissions Test Methods as well as the Fuel Economy Test Methods. Both test methods are based upon those developed by the Environmental Protection Agency for the U.S. Program. Representative production vehicles are driven 6400 kilometres and subjected to dynamometer tests under controlled laboratory conditions simulating dry, level, paved roads. The comparative rating, composed of 55% of the city rating plus 45% of the highway rating, is used to determine the overall fuel consumption rating for individual makes and models of motor vehicles. The CAFC is determined for each manufacturer by aggregating the comparative rating, based on sales and fuel efficiency data provided by the manufacturer, to arrive at a sales weighted average for the fleet.

The city test result is adjusted upward by 10% to bring the laboratory results in line with the general public driving experience in North America. The higher consumption rating is reported as the urban rating. The urban, highway and comparative rating for each model is published annually by Transport Canada in the Fuel Consumption Guide with approximately one million copies distriubted to consumers.

In addition to providing fuel efficiency and sales data, the motor vehicle manufacturers have agreed to voluntarily label their vehicles at the factory with the fuel consumption ratings of their vehicles. Thus information should be available to the new car purchaser at the point of sale. The annual Guidelines issued by Transport Canada detail specifications for the labels and how the information should be used by manufacturers in their marketing and advertising campaigns.

Transport Canada monitors manufacturers' compliance with the voluntary program by conducting selective testing of up to one hundred new vehicles which are purchased each year. Transport Canada tests have demonstrated that manufacturers are adhering to the intent of the program. To date there have been only two instances where a manufacturer has been requested to recall its vehicles because of manufacturing/components problems.

Since 1979 Transport Canada through Statistics Canada has carried out a Fuel Consumption Survey of on-road performance of the motor vehicle fleet. The survey is funded by the Interdepartmental Panel on Energy Research and Development. The data, which are collected from diaries or logs kept by a sample number of drivers for one month, allows for the calculations of fuel consumption by weight, model year, number of cylinders, distance travelled, price of fuel and Region. Estimates of on-road fuel consumption are reported on a quarterly basis and can be extrapolated to 80% of on-road vehicles. One of the purposes of the survey is to compare variances between laboratory and on-road fuel consumption.